CALIFORNIA FISH AND GAME

"CONSERVATION OF WILDLIFE THROUGH EDUCATION"

VOLUME 43 APRIL, 1957 NUMBER 2

California Fish and Game is a journal devoted to the conservation of wildlife. Its contents may be reproduced elsewhere provided credit is given the authors and the California Department of Fish and Game.

The free mailing list is limited by budgetary considerations to persons who can make professional use of the material and to libraries, scientific institutions, and conservation agencies. Individuals must state their affiliation and position when submitting their applications. Subscriptions must be renewed annually by returning the postcard enclosed with each October issue. Subscribers are asked to report changes in address without delay.

Please direct correspondence to:

LEO SHAPOVALOV, *Editor*
Department of Fish and Game
722 Capitol Avenue
Sacramento 14, California

Individuals and organizations who do not qualify for the free mailing list may subscribe at a rate of $2 per year or obtain individual issues for $0.75 per copy by placing their orders with the Printing Division, Documents Section, Sacramento 14, California. Money orders or checks should be made out to Printing Division, Documents Section.

CALIFORNIA FISH AND GAME

VOLUME 43 APRIL, 1957 NUMBER 2

Published Quarterly by the
CALIFORNIA DEPARTMENT OF FISH AND GAME
SACRAMENTO

STATE OF CALIFORNIA
DEPARTMENT OF FISH AND GAME

GOODWIN J. KNIGHT
Governor

FISH AND GAME COMMISSION

ANDY KELLY, President
Los Angeles

CARL F. WENTE, Commissioner
San Francisco

WILLIAM P. ELSER, Commissioner
San Diego

WELDON L. OXLEY, Commissioner
Redding

T. H. RICHARDS, JR., Commissioner
Sacramento

SETH GORDON
Director of Fish and Game

CALIFORNIA FISH AND GAME

Editorial Staff

LEO SHAPOVALOV, Editor-in-Chief ..... Sacramento
JOHN E. FITCH, Editor for Marine Fisheries ..... Terminal Island
CAROL M. FERREL, Editor for Game ..... Sacramento
J. B. KIMSEY, Editor for Inland Fisheries ..... Sacramento

TABLE OF CONTENTS

2—49892

ERRATUM

Report on the Distribution and Abundance of Pacific Herring (*Clupea pallasi*) Along the Coast of Central and Southern California, vol. 42, no. 3.

On page 174, lines 10 and 11 from bottom, read "Sacramento smelt (*Spirinchus thaleichthys*)" for "eulachon (*Thaleichthys pacificus*)".

LARGEMOUTH BASS TAGGING AT CLEAR LAKE, LAKE COUNTY, CALIFORNIA[1]

J. B. KIMSEY
Inland Fisheries Branch
California Department of Fish and Game

In June, 1953, a largemouth bass (*Micropterus salmoides*) tagging study was begun at Clear Lake, Lake County, to obtain statistics on angling and natural mortality. Such statistics are necessary for sensible angling regulations and are best obtained through tagging studies. Any migrations of the fish that might influence angler success are also indicated by such studies.

Clear Lake (Figure 1) is a seminatural 40,000-acre lake with a maximum depth of about 50 feet. It lies in central Lake County in northern California at an elevation of 1,325 feet. The outlet is Cache Creek, a tributary of the Sacramento River. The lake level has been partially controlled since 1915 by a dam on this outlet. The ecology and fishery of Clear Lake have been described by Murphy (1951).

In a study such as this that continues over an extended period many people participate and deserve acknowledgment. Almo J. Cordone contributed the most in time and effort, in both the field and laboratory. Leonard O. Fisk, David E. Pelgen, and George W. McCammon also assisted in the field work. Leonard O. Fisk, Ed V. Dwyer, and Robert R. Bell assisted in compilation and recording of data and tag returns.

METHODS

Capture

All fish were taken by seining. A 300-foot one and one-half-inch mesh beach seine was used. Only a relatively small area of the shore line lends itself to this type of operation and for this reason 64 percent of the fish were taken at the Paradise Valley beach. This area is located near the constriction between the upper and lower portions of the lake, called The Narrows.

Twenty-five bass were obtained from commercial carp seiners in March, 1954.

Tagging was begun on July 8, 1953, and the last fish was tagged March 25, 1954. Weather and availability of fish made this a discontinuous program and no fish were tagged during September, November, December, 1953, or February, 1954.

Three types of tags were used. Strap tags, placed on the lower jaw halfway between the epiphysis and the angle of the mouth, were discontinued after August 26, 1953, when a total of 108 had been placed. Three of these tags (2.8 percent) were returned by anglers. The longest confirmed elapsed time between tagging and return was 41 days. This

[1] Submitted for publication October 31, 1956.

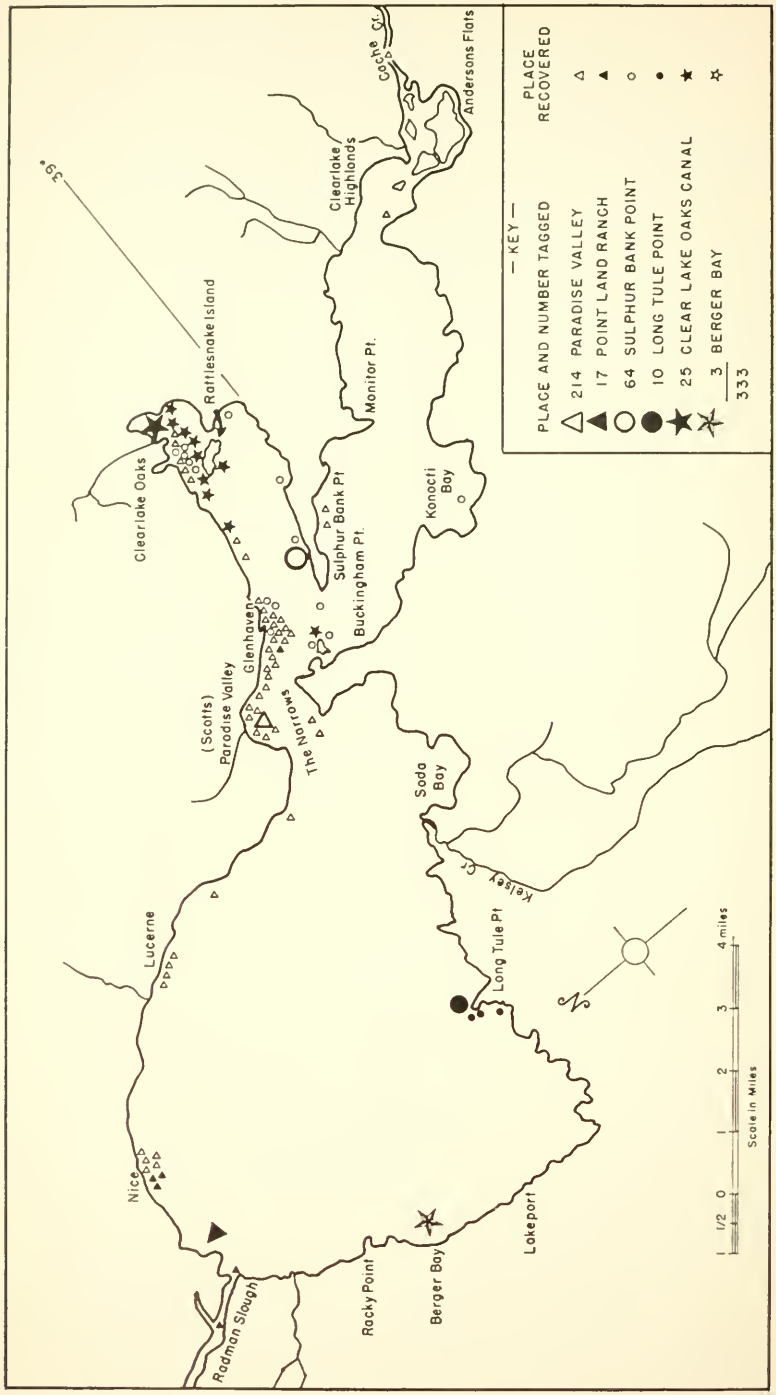

FIGURE 1. Map of Clear Lake, showing points of tagging and recapture of largemouth bass.

tag proved unsatisfactory for reasons outlined by Kimsey (1956) and is not included in any of the subsequent analyses.

Two kinds of double-wire tags were used: the staple tag and the disk-dangler tag. These tags have been described for largemouth bass by Kimsey (*op. cit.*). They are placed between the soft and spinous dorsal fins about halfway between the lateral line and the mid-dorsal line.

Staple tags were used until August 27, 1953, when it was found the disk was being forced backwards, exposing the wires to excessive abrasion and causing a large persistent sore. A total of 251 tags of this type was placed. After August 27, 1953, the disk-dangler tag was used exclusively. This tag occasionally caused a sore on the knot side when growth caused the knot to pull into the flesh. Usually, however, the sore was not persistent and scales and skin soon covered it. A total of 82 tags of this type was placed.

The average fork length of the fish tagged was 9.4 inches (range: 8.0 to 20.25 inches). There was a significant difference between the average fork length of the staple tagged bass (9.92 inches) and the disk-dangler tagged bass (12.0 inches). An inspection of Table 1 shows a twofold reason for this. The staple tagged fish, taken early in the season, had a higher percentage in the size range below 9.0 inches. By the time the disk-dangler tag was used these smaller fish were no longer available. This was primarily due to growth. The March, 1954, fish caught by the commercial seiners and tagged with disk-danglers were taken in a large 4½-inch mesh net, so that their size (mean: 16.2 inches) was considerably greater than that of the fish taken in the beach seine.

TABLE 1

Length Frequencies of Fish Tagged

Midpoint of size group	Disk-dangler*	Staple	Total
8.5	--	35	35
9.5	16	132	148
10.5	22	40	62
11.5	8	5	13
12.5	5	11	16
13.5	3	15	18
14.5	5	4	9
15.5	6	3	9
16.5	8	2	10
17.5	6	3	9
18.5	--	--	--
19.5	--	1	1
20.5	2	--	2
Totals	81	251	332

* One fish not measured.

There was no significance difference between the size of the fish tagged and the size of the fish from which tags were returned. This was true for both kinds of tags.

Tag Recovery

Dependence was placed upon voluntary returns by the angler, stimulated by posters advertising the program, talks before sportsmen's groups, and personal contact with boat livery and resort owners.

Tagging of warmwater fish in northern California has received such wide publicity that sportsmen are generally aware of the importance of tag returns.

RESULTS

Tag Returns

An adjusted chi-square test showed tag return for the disk-dangler and staple tags was independent of type of tag ($p < 0.45$). The returns of both tags are combined for all subsequent analyses.

First-year tag returns include all tags that were on the fish from 0 to 365 days. Second-year tag returns include those remaining from 366 to 730 days and third-year returns are considered to be those that remained over 730 days before being taken. This treatment was necessary because of the extended period of tagging.

The tag return data are summarized in Tables 2 and 3. During the three-year period, 94 or 28.2 percent of the total tags placed were returned. The rate of return dropped off rather precipitously in the third year. There is, however, no direct evidence of tag loss.

Using age and growth data from Murphy (1951), it was estimated that 89 percent or 297 of the tagged fish were in their second or third summer (year classes I and II). In 1956, the third year of fishing, these fish would be in their fifth and sixth summers (year classes IV and V). Taking the annual mortality figures into consideration, approximately 30 of the original 333 fish tagged remained in the population in 1956. With so few individuals available in a 40,000-acre lake, it is not surprising that returns fell off in the third year.

A seasonal aspect of the fishery was indicated by the tag returns. There appeared to be two main periods of high angler success, one in the spring and another in the fall. During the peak tourist months in the summer, fishing for largemouth bass was poor. Fish at that time

TABLE 2

Tag Return Data

Kind of tag	Total number tagged	Combined returns		Days at large					
				0-365		366-730		Over 730	
		No.	Percentage of total	No.	Percentage of total	No.	Percentage of total	No.	Percentage of total
Staple	251	67	26.7	40	15.9	26	10.4	1	0.4
Disk-dangler	82	27	32.9	14	17.1	11	13.4	2	2.4
Total	333	94	28.2	54	16.2	37	11.1	3	0.9

TABLE 3

Yearly and Monthly Return of Tags

	1953*	1954	1955	1956	Total
January	--	--	--	--	--
February	--	--	2	--	2
March	--	8	7	--	15
April	--	6	5	1	12
May	--	10	7	0	17
June	--	2	7	1	10
July	1	3	1	--	5
August	4	2	--	--	6
September	7	3	--	--	10
October	1	1	1	--	3
November	9	2	--	--	11
December	1	2	--	--	3
Total	23	39	30	2	94

* Tagging started July 8, 1953, and ended March 25, 1954.

were obtained by deep trolling with lures or still fishing with minnows. Very few were to be found in the shallows.

These periods coincide well with climatological information. Tag returns virtually cease in the fall when the mean daily air temperature drops below 45 degrees. They resume in the spring when the temperature rises above 45 degrees and continue at a good rate until the temperature goes above 70 degrees. The summer slump starts at that time and the returns are slow until fall when the mean daily air temperature drops below 70 degrees.

The spring season also coincides rather well with post-winter and spawning activity and accounted for 57.6 percent of the total tags returned. The summer period had 13.1 percent, the fall 26.1 percent, and the winter 3.2 percent of the total tag returns. Inclement weather during the winter, sharply reducing the effort, could account for much of the poor tag return during that period. However, seining during the winter season produced virtually no fish.

The seasonal aspect of the fishery as indicated by the tag returns is also borne out by angler opinion, test seining along the shore, and by creel census data (Pintler, 1955). His data showed that 65 percent of the annual catch in 1954 was taken during the spring, 7 percent during the summer, 19 percent during the fall, and 9 percent during the winter season.

Suitability of Tags

Despite the sharp dropoff in returns in the third year, there is little indication that either tag was shed. One unverified report was received of a fish found with two wires protruding from the side but no tag. After the disk had turned over on the staple tag, the wires were subjected to more than normal abrasion. This was an important consideration in discarding the staple tag. However, no tag loss has been experienced with the disk-dangler tag and the rate of return in the third year also dropped off for this tag.

Movement of Fish

In general, the migration of Clear Lake bass is undirected. Eighty returns carried data that could be used for migration studies. The average distance traveled was 4.5 miles.[2] Seventeen individuals traveled less than one mile or not at all. The greatest distance traveled was from Point Land Ranch near Rodman Slough to Glenhaven, a straight-line distance of about 18 miles. This distance was covered in 99 days. Sixty-four percent of the fish were tagged at The Narrows. These showed a tendency to migrate in the direction of Clearlake Oaks more than in other directions. This tendency is magnified, since most of The Narrows anglers appeared to headquarter in the vicinity of Glenhaven. Except for the one individual reported above, the fish tagged in the Rodman Slough, Long Tule Point, and Clearlake Oaks Canal areas did not move any great distance. The mean distance traveled for fish from these areas is 2.3 miles.

A source of error enters into the migration data because fishermen tend to report their catch nearer to their headquarters than the actual fishing spot. This tendency is believed to increase the distance rather than to compensate, and to give apparent direction to migration.

Harvest

Using methods outlined by Ricker (1948), in which the survival rate is estimated as the ratio of one year's recaptures to the preceeding year, the weighted estimate of the annual survival rate was 44 percent. The annual expectation of death from all causes for the tagged population was therefore 56 percent. This over-all annual mortality rate was further refined to give a 20 percent rate of exploitation and a 36 percent annual expectation of death from natural causes. This means that for the duration of the experiment the anglers were annually cropping 20 percent of the population represented by the tagged sample. This is a quite moderate rate of harvest. There is no problem of overuse at Clear Lake. While no good yardstick is available, it is reasonable to assume the angler take could be doubled with no cause for concern.

Because of the limited data, these figures are of a general nature. The sharp drop off in tag returns during the third year will increase the calculated rate of exploitation and lower the annual survival rate. If this decrease in rate of tag return was due to tag shedding, the error would be real and serious. However, the evidence is against tag loss and in favor of death from natural causes, a situation tending to give the present figures more weight.

Unrepresentative first-season fishing mortality caused by tagging while fishing was in progress was not found to be significant. However, the qualification of limited data also applies here.

There appear to be no annual rate of harvest figures for largemouth bass that are strictly comparable with the one presented above. Rates have been reported (Dequine and Hall, 1950; Manges, 1950; Fisher, 1953; Carter, 1955; Chance, 1955; Stroud and Bitzer, 1955) varying from 9 to 41.6 percent. However, they were derived from jaw tagged fish from which only one-year returns were available.

Murphy (1951) found that although several important changes had occurred in the fish populations of Clear Lake the angler, other than

[2] All distances listed are straight-line distances and therefore minimal.

reducing the number of large fish, has had no noticeable effect on the populations. The moderate angling regulations now in effect are largely the result of this information. The direct evidence of tag returns strengthen the position of these regulations. It is entirely possible that they could be even further relaxed, since the fish are evidently protected more by natural means than by laws.

Angling pressure at Clear Lake has increased during the past decade probably at a rate commensurate with the general population increase in the State. There is no evidence at hand indicating this increase in pressure has affected the largemouth bass supply.

There are fluctuations in abundance of bass and angler success from year to year. These are due to natural causes or to man-made conditions other than angling. A more positive approach to improving fishing and smoothing out the year-to-year fluctuations in abundance and success would be to determine what these factors are and to find ways of modifying them.

An example of this approach at Clear Lake was the introduction of the golden shiner, a lake spawning forage fish. This was done because irrigation demands and to some extent climatological conditions had limited the stream flow into the lake to such an extent that the stream-spawning native forage fish were seriously inhibited.

SUMMARY

A tagging study at Clear Lake, which started in June, 1953, and terminated in March, 1954, tagged 441 largemouth bass.

The jaw tags proved unsatisfactory and so were discontinued and not used in the calculation of vital statistics.

There was no difference in the return of the staple and disk-dangler tags, so they were treated together.

A total of 333 disk-dangler and staple tags was placed. In three years 94 (28.2 percent) were returned. Of this total, 54 (57.4 percent of total return) were received the first year, 37 (39.4 percent of total return) the second year, and 3 (3.2 percent of the total return) the third year.

In general, the migration of largemouth bass in Cleak Lake is undirected, although there is some indication that fish in the shallower northern section are more sedentary.

Survival was calculated to be 44 percent. The annual expectation of death is therefore 56 percent. Of this annual mortality, 20 percent is attributed to fishing and 36 percent to natural causes. Overfishing is not a problem, but the extent to which the take can be increased is unknown at this time.

REFERENCES

Carter, Ellis R.
1955. The harvest and movement of game fishes in Kentucky Lake and its tailwaters. Kentucky Dept. of Fish and Wildl. Resources, Fish. Bull. no. 15, 14 p.

Chance, Charles J.
1955. Unusually high returns from fish-tagging experiments on two TVA reservoirs. Jour. Wildl. Mangt., vol. 19, no. 4, p. 500-501.

Dequine, John F., and Charles E. Hall, Jr.
1950. Results of some tagging studies of the Florida largemouth bass *Micropterus salmoides floridanus* (LeSueur). Amer. Fish. Soc., Trans., vol. 79, (1949) p. 155-166.

Fisher, Charles K.
1953. The 1950 largemouth black bass and bluegill tagging program in Millerton Lake, California. Calif. Fish and Game, vol. 39, no. 4, p. 485-487.

Kimsey, J. B.
1956. Largemouth bass tagging. Calif. Fish and Game, vol. 42, no. 4, p. 337-346.

Manges, Daniel E.
1950. Fish tagging studies in TVA storage reservoirs, 1947-1949. Tenn. Acad. Sci., Jour., vol. 25, no. 2, p. 126-140.

Murphy, Garth I.
1951. The fishery of Clear Lake, Lake County, California. Calif. Fish and Game, vol. 37, no. 4, p. 439-484.

Pintler, Herbert E.
1955. The 1954 fishery of Clear Lake, Lake County, California. Calif. Fish and Game, Inland Fish. Branch, Admin. Rept., no. 56-2, 12 p. (Mimeo.)

Ricker, William E.
1948. Methods of estimating vital statistics of fish populations. Ind. Univ. Publ., Sci. Series no. 15, 101 p.

Stroud, Richard H., and Harold Bitzer
1955. Harvests and management of warm-water fish populations in Massachusetts' lakes, ponds, and reservoirs. Prog. Fish-Cult., vol. 17, no. 2, p. 51-63.

SURVIVAL OF PRECOCIOUSLY MATURE KING SALMON MALE PARR (*ONCORHYNCHUS TSHAWYTSCHA* JUV.) AFTER SPAWNING[1]

O. H. ROBERTSON
Department of Biological Sciences
Stanford University, Stanford, California

The occurrence of death following the spawning of the Pacific salmons (genus *Oncorhynchus*) is an almost unique phenomenon, since only a very few other vertebrates are known to die regularly after their first reproduction. These are all fishes; they include the eels (genus *Anguilla*), the lampreys (family Petromyzontidae), the eulachon (*Thaleichthys pacificus*), and a group of small annual fishes (genus *Cynolebias*) of the killifish family. The last group lives in water which dries up once a year. They spawn in the mud as the pools begin to dry and the eggs, buried in the damp mud beneath the hardened crust, hatch after the next rain. Death occurs after spawning even though the fish are maintained in water (Myers, 1952). The ayu (*Plecoglossus altivelis*), a small salmon-like fish of Asiatic rivers, and two small marine gobies of northern Europe (*Aphya pellucida* and *Crystallogobius nilssoni*) also are said to be annuals.[2]

The nature of the post-spawning death presents a problem of great interest. Physical exhaustion resulting from long migrations can be excluded as a principal factor, since salmon running up short streams may come to the spawning ground in excellent condition, and after shedding their sex products, undergo degenerative changes which lead rapidly to death. Is it the loss of sex products that initiates this lethal process, or some profound physiological change associated with sexual maturation, or is the life cycle of each species of Pacific salmon sharply limited, spawning constituting the final phase? An approach to the study of this subject has been made by observing the fate of certain individual salmon which spawn long before the age at which their species commonly matures.

There occurs in natural as well as in hatchery populations of young king salmon (*O. tshawytscha*) and silver salmon (*O. kisutch*) a curious phenomenon of precocious sexual maturity in a small percentage of the male fish when less than a year of age. (King salmon spawning runs are usually composed of fish in their first through their sixth year of life, dominated by those in their third and fourth years. Silver salmon spawn in their second, third, and fourth years, with three-year fish dominating.) Do these little males die after losing their sperm? The

[1] Submitted for publication October, 1956. This work was aided by a grant from the American Philosophical Society, Philadelphia.
[2] I wish to express my appreciation to Dr. George S. Myers, Natural History Museum, Stanford University, for information on this subject.

author has been able to find very little information on this subject. Rutter (1902) described precociously mature male king salmon parr in the Sacramento River. Milt secured from such fish fertilized adult salmon eggs which hatched normally. He stated that nothing is known about their survival after spawning but considered that they may survive and return later from the sea as grilse. Donaldson (personal communication)[3] examined the preserved specimens of six kokanee salmon (nonmigratory sockeye or red salmon, *O. nerka kennerlyi*) 9 to 10 inches in length caught in the spring of the year in Chapman Lake, Washington. Five of these fish, three males and two females, showed undoubted evidence of having spawned previously—presumably during the preceding fall. All had food in their stomachs.

An opportunity to study a hatchery population of precociously mature king salmon parr was provided by the California Department of Fish and Game at their Prairie Creek Hatchery near Orick, Humboldt County. The following report consists of observations on a group of such fish maintained for five months following full sexual maturity and artificially induced spawning.

THE EXPERIMENTAL SALMON

The salmon employed in the experiment were hatched from eggs and sperm obtained at Fall Creek, a tributary of the Klamath River. Hatching was completed about the middle of January, 1954. Examination for the occurrence of sexual maturity (by expression of milt) was begun September 19, 1954, in a stock of approximately 5,000 fish. Two hundred were tested each week. None were found until October 3. From that time until November 21 there was a gradual increase in the number of ripe parr collected weekly. The total represented 2.3 percent of some 2,000 of the population examined. The actual incidence may have run a little higher, since on November 24, 42 additional ripe parr were picked out from the remaining but uncounted stock primarily on the appearance of a lemon-yellow coloration of the belly and the pectoral, pelvic, and anal fins, characteristic of the precociously mature male. Practically all such fish were found to be ripe.

The age of the salmon at the initiation of the experiment on November 24, 1954, was a little over 10 months. They were in excellent condition and had grown normally.

PLAN OF THE EXPERIMENT

Of 76 ripe parr collected, 60 were kept for the experiment and 16 killed for examination of the testes. One hundred thirty immature fish were held as controls. All the fish were measured individually (total length) and weighed in groups of 10 or 20 after anesthetizing in a 1:25,000 solution of tricaine methanesulphonate. From 40 of the ripe parr milt was expressed (before weighing) as completely as possible. These were marked by clipping the adipose and right pelvic fins, as distinguished from the non-expressed with adipose and left pelvic fins clipped. The controls were not marked. These data are displayed in Table 1. It will be noted that the immature controls averaged one-half

[3] I am much indebted to Professor Lauren R. Donaldson, University of Washington School of Fisheries, for sending me a transcript of his unpublished notes on these salmon.

TABLE 1

Lengths and Weights of Salmon at Beginning of Experiment

Number and classification of fish in each group	Average length, inches*	Average weight grams
40 ripe males, milt expressed	4.75	19.6
20 ripe males, milt not expressed	4.75	19.7
130 immature controls†	5.25	23.5

* Total length.
† Later 61 were found to be males.

inch longer and four grams heavier than the mature fish. The fact that the ripe parr from which milt had been expressed weighed essentially the same as the nonstripped group may be accounted for, at least in part, by the finding in the autopsied group that the testes of many of the latter group were partly spent (Table 2).

TABLE 2

Data on Ripe Parr Autopsied at Beginning of Experiment

Salmon number	Length, inches	Weight, grams	State of testes	Weight of testes, grams	Percentage testes weight of body weight
1	5.0	23.5	Soft oozing sperm	5.25	22
2	4.8	18.5	Partly spent	1.25	7
3	4.7	17.5	Partly spent	2.25	13
4	4.5	16.5	Partly spent	1.5	9
5	4.2	13.25	Soft oozing sperm	2.75	21
6	3.8	9.0	Mostly spent	0.3	3
7	5.4	31.5	Soft oozing	6.5	21
8	5.1	22.5	Partly spent	2.4	11
9	5.4	29.5	Soft oozing	7.0	24
10	4.6	19.5	Soft oozing	3.7	19
11	4.7	18.0	Soft oozing	1.3	7
12	4.3	15.0	Soft oozing	3.2	21
13	5.1	23.5	Partly spent	2.5	11
14	5.0	22.0	Partly spent	2.3	10
15	4.2	15.0	Partly spent	1.5	10
16	4.1	11.25	Partly spent	1.5	13

Average — 14

All the experimental salmon were placed in the same trough, where they were maintained for the duration of the experiment.

STATE OF THE TESTES

In the 16 ripe parr autopsied, the testes were found to be mostly in a partly spent state. A summary of the findings is given in Table 2. The size of the testes in relation to body weight was surprisingly large. In 6 of the parr which appeared not to have begun to lose their sperm, the testes comprised 19 to 24 percent of the body weight. Figure 1 (upper)

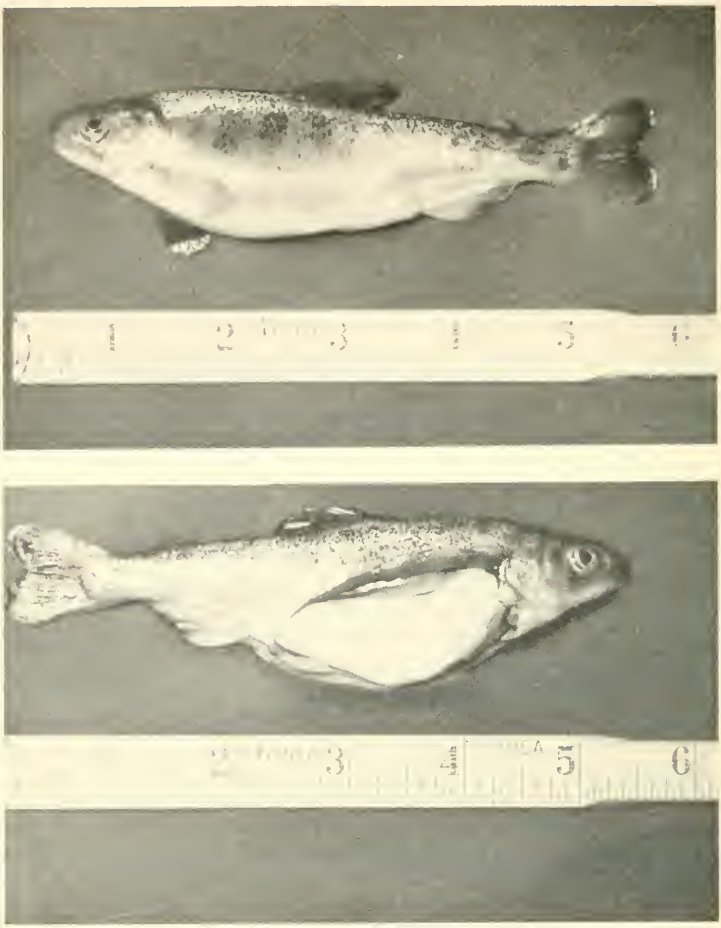

FIGURE 1. *Upper:* Precociously mature king salmon parr 10 months of age. *Lower:* Same salmon as above with right testis exposed. Weight of testes 6.5 grams; equals 21 percent of body weight.

shows the bulging abdomen of salmon No. 7, whose testes represented 21 percent of the body weight. The exposed right testis of the same fish is exhibited in Figure 1 (lower). The author has been unable to find comparable data for adult male salmon, but believes from personal observations that the testes weights of the precociously mature parr are relatively much greater than those of the sexually ripe adults. So, if loss of sex products is the precipitating cause of the sequence of changes ending in death, one would certainly expect these fish to die.

Examination of the scales for absorption at the periphery was made in only six of these fish, since similar observation had been made in 30 such parr previously. This was done in an earlier unfinished experiment, described later in the present paper. None of the scales showed absorption.

FERTILITY OF PRECOCIOUSLY MATURE MALES

While there is reason to believe that these sexually mature male parr produce fertile sperm, as shown by Rutter (*op. cit*) for wild king salmon and by Orton, Jones, and King (1938) for Atlantic salmon (*Salmo salar*), it was believed desirable to secure conclusive evidence on this point for the particular population under observation. Accordingly, eggs from two adult females were fertilized with milt from ripe parr—two parr to each female. The results are displayed in Table 3. The percentage of eyed eggs and the hatching of eggs from female No. 1 were fully as good as those occurring when salmon eggs are fertilized with milt from adult males. In the case of female No. 2 the resulting hatch was lower than expected. The early mortality of the latter fry was, however, very low.

TABLE 3

Eggs of Adult Females Fertilized by Sperm of Precociously Mature Parr

	Number of eggs			Percentage mortality at the end of 2 months
	Taken	Eyed	Hatched	
Female No. 1, partly spent, weight approx. 12 lbs.	1,200	1,161 96.8%	1,120 90.3%	3.0
Female No. 2, ripe, weight 23 lbs.	4,290	3,444 80.3%	3,362 78.4%	0.7

INTERIM OBSERVATIONS

The spent males gradually lost their distinctive lemon-yellow coloration of belly and fins and became indistinguishable from the immature controls. They fed well, continued to grow, and only four of the group died, a mortality only slightly higher than that exhibited by the immature control males, of which three succumbed (Table 4).

CONDITION OF THE EXPERIMENTAL SALMON AT THE END OF FIVE MONTHS

On April 19, 1955, all the salmon parr in the experiment were measured and weighed, scale samples were taken, and the fish were then killed by immersion in a lethal concentration of tricaine methanesulphonate, and autopsied. The testes of the three different categories were weighed in groups. Samples of each were put in Bouin's solution for histology.

The spent testes were strikingly different in appearance from those of the immature controls. The former were larger, flesh-colored, and lacked the surface marking of the longitudinal artery which characterized the undeveloped male gonad. There was also a difference in appearance between the expressed and non-expressed testes. The latter were a little larger and contained small amounts of milt which could be squeezed out of the incised gland, while the former were "dry." This observed difference in milt content was borne out by the testes weights of the two groups. Testes of the milt-expressed group averaged 143 mg.,

TABLE 4

Salmon at End of Experimental Period of Five Months

Number and classification of salmon in each group	Average length inches	Percentage gain in length*	Average weight grams	Percentage gain in weight*	Percentage mortality	Scale absorption	Average weight testes mg.
38 ripe males, milt expressed	5.5	15.8	26.8	37.1	5.0	0	143
18 ripe males, milt not expressed	5.5	15.8	27.3	38.1	10.5	0	201
Combined data for 56 ripe males	5.5	15.8	27.0	37.4	6.6	0	172
58 immature male controls	6.2	18.1	37.5	60.0	4.9	0	44

* Calculated from figures given in Table 1.

while those from the non-expressed weighed 201 mg. The average weight of the immature control testes was only 44 mg.

The data secured at autopsy are summarized in Table 4. Of chief interest was the finding that the spent salmon parr showed almost as much increase in length at the end of five months as did the immature controls. The latter, however, gained more weight, as might be expected. None of the 57 spent fish showed any absorption of scales.

HISTOLOGY OF TESTES

Microscopic examination of testes taken from the sexually ripe parr sacrificed at the beginning of the experiment showed them to be in

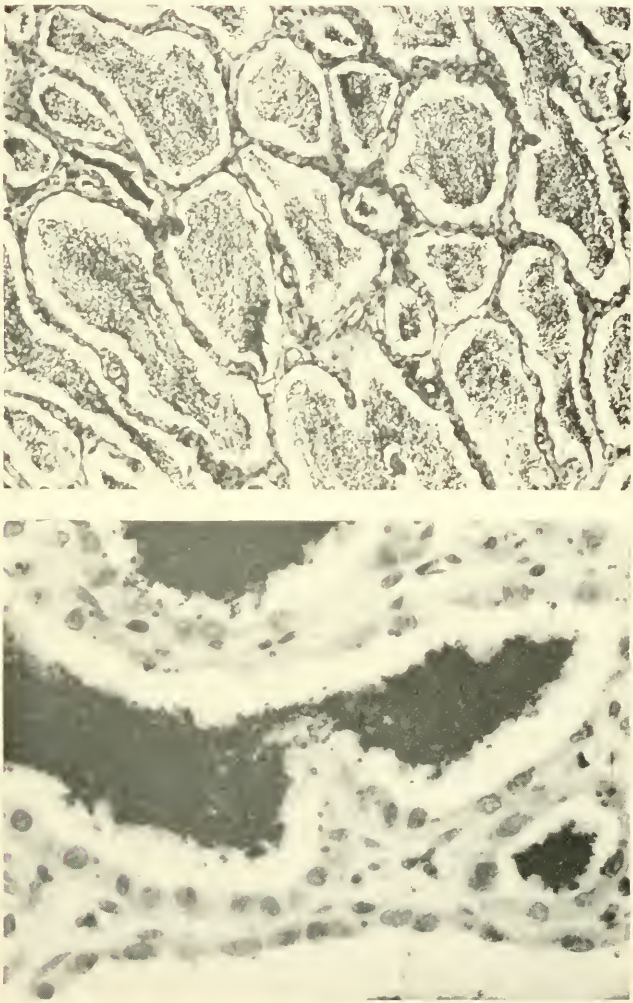

FIGURE 2. *Upper:* Spent testis of king salmon parr. Some lobules still contain considerable numbers of spermatozoa; others are almost empty. X 100. *Lower:* Higher magnification of same testis shown above. Note spermatogonia lining lobule are almost all intact. Dense masses of spermatozoa lie in the middle of the lobules. X 500.

varying stages of post maturity, i.e., partly spent. The only free sex cells were spermatozoa. In some instances relatively few spermatozoa remained. Figure 2 (upper and lower) shows the typical appearance of such a testis: small lobules with much thickened interlobular septa. Some of the spermatogonia lining the lobules showed evidence of degeneration, necrosis of cytoplasm, and occasionally vacuolization. Evidence of cell injury varied much between different fish. Some testes appeared essentially normal. In others, considerable degenerative change was observed.

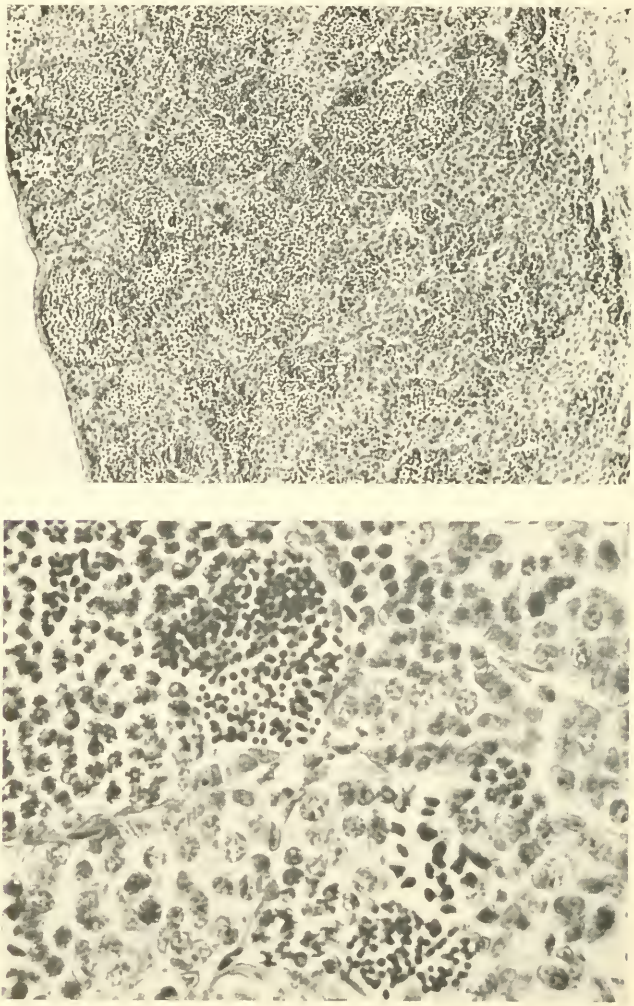

FIGURE 3. *Upper:* Renewed spermatogenesis in spent parr testis five months after spawning. X 100. *Lower:* Higher magnification of an area in same testis. Larger cells are spermatagonia, next sizes smaller are primary and secondary spermatocytes, while small solid dots are spermatids. Cells appear normal. X 500.

Testes secured from the spent parr five months after the loss of their sperm revealed a picture of renewed spermatogenesis. In certain cases the process was well advanced, as shown in Figure 3 (upper and lower), and had progressed to spermatid formation. Others showed only multiplication of spermatogonia, with frequent mitoses. In most of the testes examined there was much more fibrous tissue in the septa and capsule than was observed in the testes taken from ripe parr at the beginning of the experiment. Some showed large areas of fibrosis, giving the appearance of scars. The fibrous tissue in certain testes was arranged concentrically around a mass of degenerating cells (Figure 4, upper). On higher magnification there was seen within the central

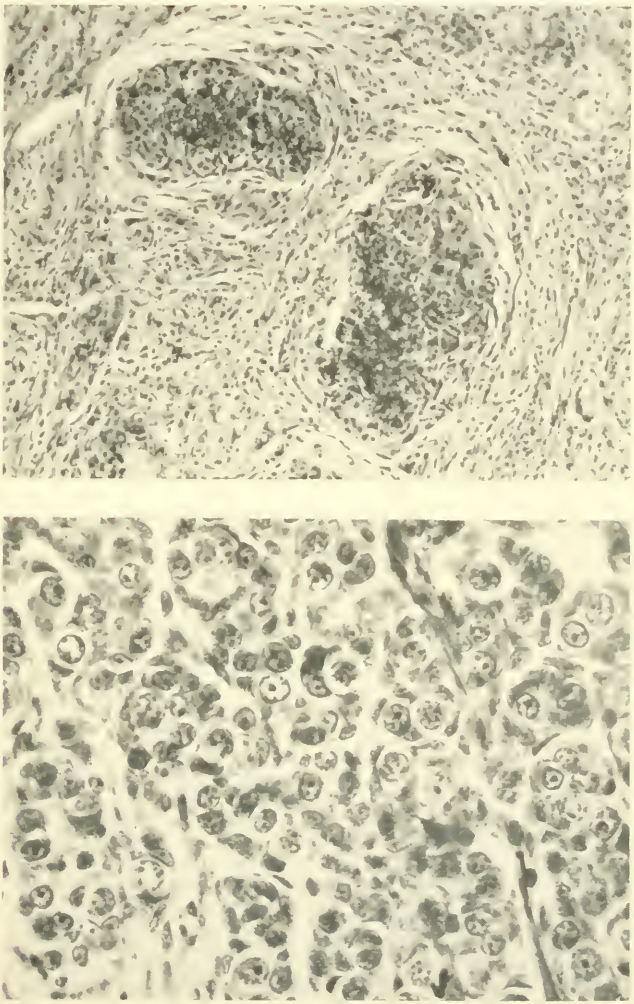

FIGURE 4. *Upper:* Testis of another spent parr five months after spawning, shows marked fibrosis. The scar tissue is arranged concentrically around a mass of degenerating cells. X 150. *Lower:* Infantile testis of control salmon killed at same time as fish whose testis is shown in Figure 3. Here the only sex cells are small nests of resting spermatogonia. X 500.

mass a large number of small, varying-sized, dark-staining particles suggesting bacteria, since they appeared to be encapsulated. However, on appearance alone disintegrating spermatozoa cannot be excluded.

Testes of the immature controls at the end of the experiment were found to be in a typical infantile state, as exhibited in Figure 4 (lower). The only sex cells seen are spermatogonia which are arranged in small nests.

OFFSPRING OF SMALL PRECOCIOUS MALES AND ADULT FEMALES

The fry resulting from the fertilization of adult salmon eggs with parr sperm continued to develop normally. Beginning at the age of nine months and continuing till the end of their first year, 200 were examined each week for the prescence of precociously mature males. Not one was found.

DISCUSSION

Death of the adult king salmon occurs in almost all instances within one to two weeks after spawning. By means of tagging Rutter (1902) determined that fall-run king salmon live only an average of two weeks after reaching the spawning ground and believed that most of them die shortly after spawning. Several of his marked fish lived as long as 16 days. It is possible that a rare spent salmon may survive for longer periods, but that none live to spawn a second time is attested by the failure to find a single spawning mark in tens of thousands of scales examined by many workers.

The fact that the spent male parr of the present study were not only alive but growing normally at the end of five months after full sexual maturity and expulsion of their sperm would seem to provide sufficient evidence that they had escaped the fate of their progenitors. Additional evidence for continued life expectancy was the presence of renewed spermatogenesis.

Age appears to be the deciding factor in determining death or survival. Possibly related to this factor are certain differences between the ripe parr and the mature male adult salmon; namely, the parr do not show the hooked jaw, the hump back, the brilliant coloration, and absorption of scales exhibited by the full-grown fish. These changes are all presumably the result of increased pituitary activity and signify a much more diversified functioning of this gland in the adult salmon. It is conceivable that other changes characteristic of the post-spawning state may be also influenced by the pituitary.

The histological appearance of the testes of the spent parr differs considerably from that of the post-spawning adult salmon described by Weisel (1943). He found that the residual spermatogonia showed marked degeneration; vacuolization and necrosis of the cytoplasm and pycnosis of the nuclei. In the testes of the spent parr a moderate amount of degenerative change was observed, obviously not enough to prevent the re-establishment of spermatogenesis, but sufficient to cause considerable scarring. Examination of the testes of grilse for scars might provide a clue as to whether they are the previously spent ripe parr returning for a second spawning.

Why a small percentage of king salmon populations should mature at an early age poses an interesting question. Insofar as can be deter-

mined, environmental and nutritional influences can be eliminated. Is it genetic? Such data as we have suggests that this may be the case. A duplicate of the present experiment was set up two years previously, in which the population producing the ripe parr was derived from eggs secured from Fall Creek, a tributary of the Klamath River. Two to three percent of precociously mature parr occurred in this hatch. The experiment was terminated after seven weeks by a flood. Up to that time the spent parr were all alive and doing well. The next year eggs were obtained from Redwood Creek, a short coastal stream. No ripe parr occurred in this population of young salmon. Then, to secure material for the present experiment, salmon from Fall Creek were again used, with the resulting two to three percent of ripe parr. Finally, to test the fertility of the precociously mature parr, salmon from Redwood Creek were used for the source of eggs. The resulting hatch, as stated above, produced no ripe parr. More extensive observations would, of course, be needed to be sure that certain runs or races of salmon carry the gene or genes for precocious male sexual maturity and others do not.

SUMMARY

As an approach to the study of the nature of post-spawning death of the Pacific salmons, an experiment was conducted to determine the fate of certain king salmon parr which mature sexually in their first year of life. Sixty such ripe parr were held in a hatchery trough, together with 120 immature controls, 61 of which were later found to be male fish. Autopsy of other mature parr from the same population showed relatively huge testes, comprising as much as one-fourth of the body weight. Test of the maturity of the sperm of these fish was made by fertilizing the eggs of adult females. The eggs hatched and the young salmon developed normally.

At the end of five months the spent males had survived and grown as well as the immature controls. Histological examination of the testes of the ripe parr taken at the beginning of the experiment showed them to be completely mature or partially spent. Five months later the spent parr exhibited renewed spermatogenesis, while the controls had infantile testes. Age appears to be the deciding factor in determining death or survival of this species of salmon following spawning.

ACKNOWLEDGMENTS

The author wishes to express his very sincere appreciation to the California Department of Fish and Game for providing the opportunity to carry out the above experiment. Especial thanks are due Monte R. Brickey, Steven C. Smedley, Carleton Rogers, and Duane T. Rodman for their generous assistance during the study.

REFERENCES

Myers, G. S.
1952. Annual fishes. Aquarium Jour., vol. 23, no. 7, p. 125-141.

Orton, J. H., J. W. Jones, and G. M. King
1938. The male sexual stage in salmon parr (*Salmo salar* L. juv.). Royal Soc. London, Proc., series B, vol. 125, p. 103-114.

Rutter, C.
1902. Natural history of the quinnat salmon. A report on investigations in the Sacramento River 1896-1901. U. S. Fish Comm., Bull., vol. 22, p. 65-141.

Weisel, G. F.
1943. A histological study of the testes of the sockeye salmon (*Oncorhynchus nerka*). Jour. Morph., vol. 73, no. 2, p. 207-229.

DETERMINING THE SEX OF DRESSED PHEASANTS[1]

MILTON HILDEBRAND
Department of Zoology
University of California, Davis

In certain prosecutions of game law violators it would be desirable to establish the sex of a pheasant from the dressed bird. Some hunters and wardens can sex such birds with accuracy on the basis of the greater size and firmness of the body of males; however, a judge may quite properly require evidence established by exact methods. This paper describes sexual differences evident in dressed pheasants as determined in a study of the soft parts of five male and five female birds, and of the skeletons of 28 males and 25 females.

Most of the birds used were reared at the Yountville State Game Farm. Helpful suggestions were received from L. W. Taylor, Department of Poultry Husbandry, University of California, and Chester Hart, California Department of Fish and Game. The figures were drawn by my wife, Viola M. Hildebrand.

SOFT PARTS

When dressing his pheasant the hunter removes the feathers, head, unfeathered portion of the legs, and most or all of the viscera. If one or more small feathers have been overlooked where the skin of the neck was cut, they will establish the sex of the bird: when clean and dry they are tipped with dark iridescent blue in the male, and with a shade of tan in the female. Feathers found where the legs have been cut are a darker brown in the cock than in the hen, but quite small feathers in this position will not establish the sex.

Most hunters skin their birds or pluck them cleanly; the examiner must therefore turn next to the body cavity for clues to sex. If one or both of the small, ovoid, yellowish testes, or the single, flattish, white-spotted, gray ovary is in position at the forward end of the kidney, the search is over.

However, the sex organs are usually removed, or at least damaged, when the bird is eviscerated. Yet the kidneys are often left in the bony hollows of the back—the usual practice when poultry is dressed for market. Studies of chickens (Latimer and Osborn, 1923) have shown that the kidneys, unlike the liver and some other organs, are nearly identical in the two sexes. However, the sex ducts that traverse the kidney afford sure identification, and the smaller of these may remain if the kidneys are present.

The small, yet tough, yellowish ureter emerges from the kidney at a point about two-thirds of the length of that organ from its forward end, and runs back to the cloaca. The sperm ducts (deferent ducts)

[1] Submitted for publication July, 1956.

take their origin at the testes, run back adjacent to the dark-red renal veins, and continue lateral to the ureters. In cocks of three to four months of age these ducts are nearly straight and only faintly visible; by four and one-half months they have become more evident and are tightly convoluted, as shown in Figure 1, but a hand lens may still be required to reveal the convolutions.

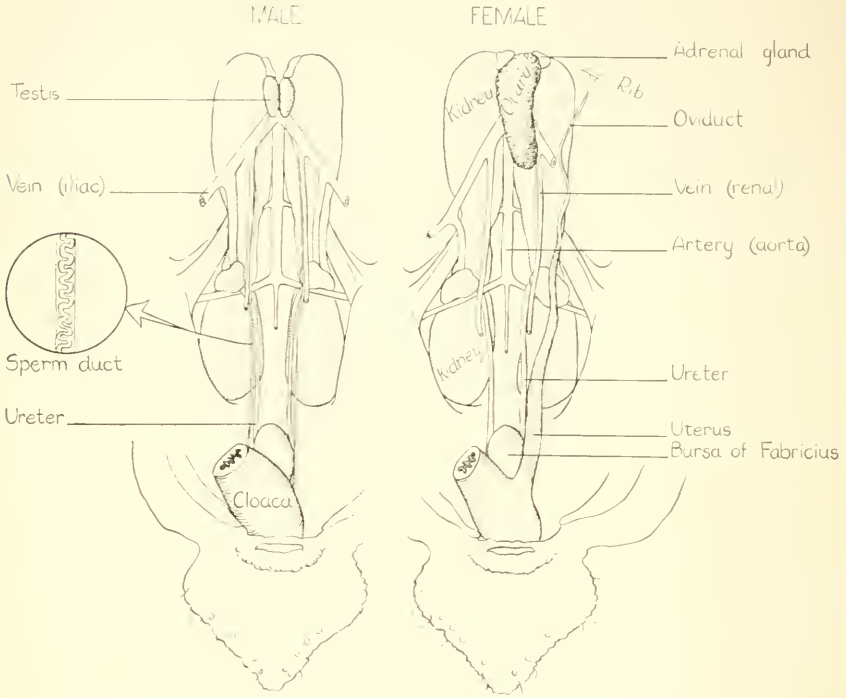

FIGURE 1. Urogenital organs showing structures that (when present) indicate the sex of a dressed pheasant.

The vestigial sperm ducts of the female are too minute to be surely identified after the viscera have been disturbed.

The oviduct and uterus on the right side of the body are represented by a mere rudiment, which will almost certainly have been removed with the cloaca. The left oviduct has its origin lateral to the forward end of the kidney. It is a whitish or yellowish duct of variable size. Opposite the middle of the kidney it expands into the shell gland, or uterus. All of the uterus may have been removed with the cloaca, yet if a portion remains it is easily recognized by its relatively large size and by the folds that cross the organ diagonally, as illustrated.

All of the reproductive structures are much larger during the breeding season. They return rapidly to the involuted condition soon thereafter, and are then scarcely more evident in old birds than in the young of the year.

SKELETON

If the urogenital ducts are not available, the search for clues to the identification of sex must be carried elsewhere. Latimer and Rosenbaum (1926) have shown that with turkeys and chickens there is less individual variation in the skeleton than in other organ systems. Variability is equal in the two sexes (Schneider and Dunn, 1924). Further, for several reasons, linear measures of skeletal parts of poultry show less individual variation than do skeletal weights (Latimer, 1927; Latimer and Wagner, 1941).

The most prominent sexual dimorphism in the pheasant skeleton is that of size, and in other fowl the skeleton shows greater sex differences in size than do other organ systems (Latimer, 1925 and elsewhere). Schneider and Dunn (*op. cit.*) reported high correlation in size variations of different bones.

It follows that linear measures of the skeleton should demonstrate differences between cocks and hens if they can be determined in the dressed bird.

Birds of 4 to 17 months of age were studied. In domestic fowl, female skeletons mature faster than do those of males (Latimer, 1927), but age-class analysis demonstrated that regardless of sex, the skeletons of pheasants four months of age could not be distinguished from those of older birds by linear measures.

Since some parts of the skeleton may be broken by shot, it will be useful to present measurements for a number of bones; however, since they are not equally diagnostic, Table 1 shows only those five of the 21 measures tested for which means for the two sexes differ by four or more standard deviations. Ten other measurements showed corresponding differences between three and four standard deviations. The bones listed in the table are identified in Figure 2.

TABLE 1

Differences Between Cock and Hen Pheasants in the Size of Certain Bones *

Measurement	Cocks			Hens		
	No.	Mean	Standard deviation	No.	Mean	Standard deviation
Depth of keel	27	46.81±.29	1.50	24	38.98±.36	1.76
Length of femur	27	85.21±.37	1.88	25	76.12±.41	2.04
Length of tibiotarsus	28	112.73±.60	3.11	25	99.62±.50	2.49
Length of coracoid	27	53.57±.29	1.48	25	47.24±.28	1.39
Length of humerus	28	76.78±.41	2.11	24	68.62±.38	1.87

* Measurements in millimeters.

Measurements were taken to the nearest tenth millimeter. Lengths of long bones are maximum over-all lengths. The depth of the keel of the breast bone was measured in the plane of the keel from its deepest extremity to the upper edge of the trough of the saddle that receives the lower ends of the ribs.

Results agree with those of Latimer's work on the chicken (1927 and elsewhere) in finding that the humerus and tibiotarsus show rela-

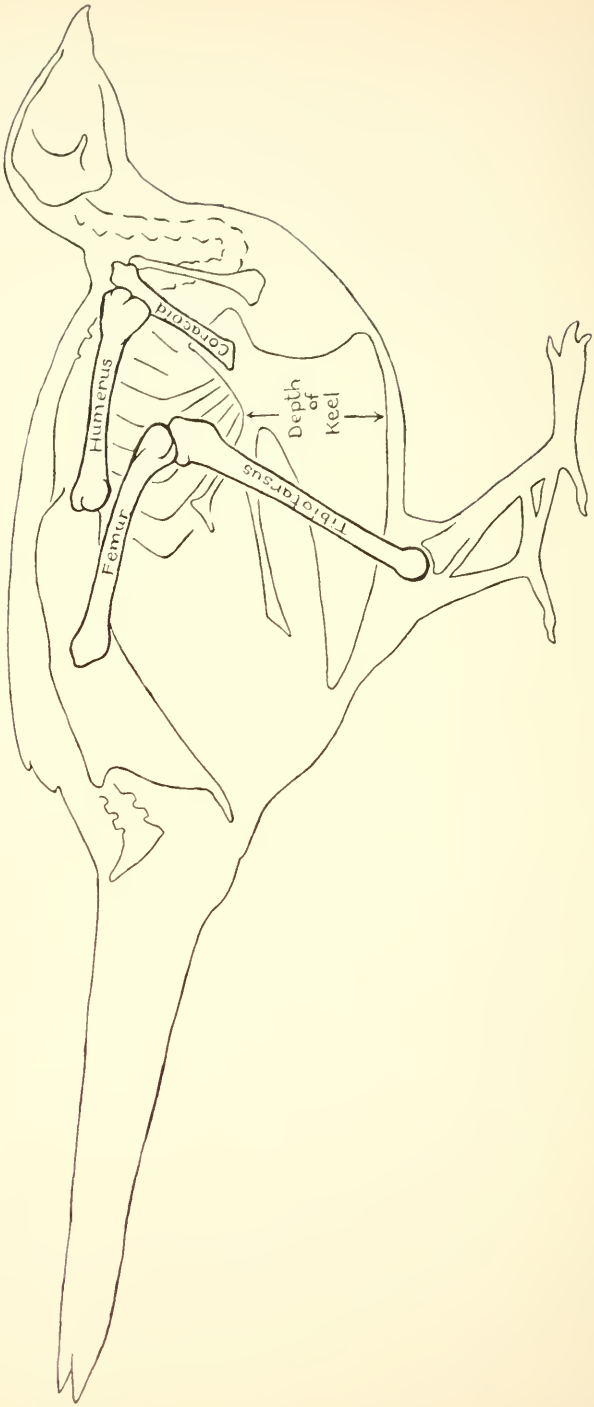

FIGURE 2. Identification of the bones listed in Table 1.

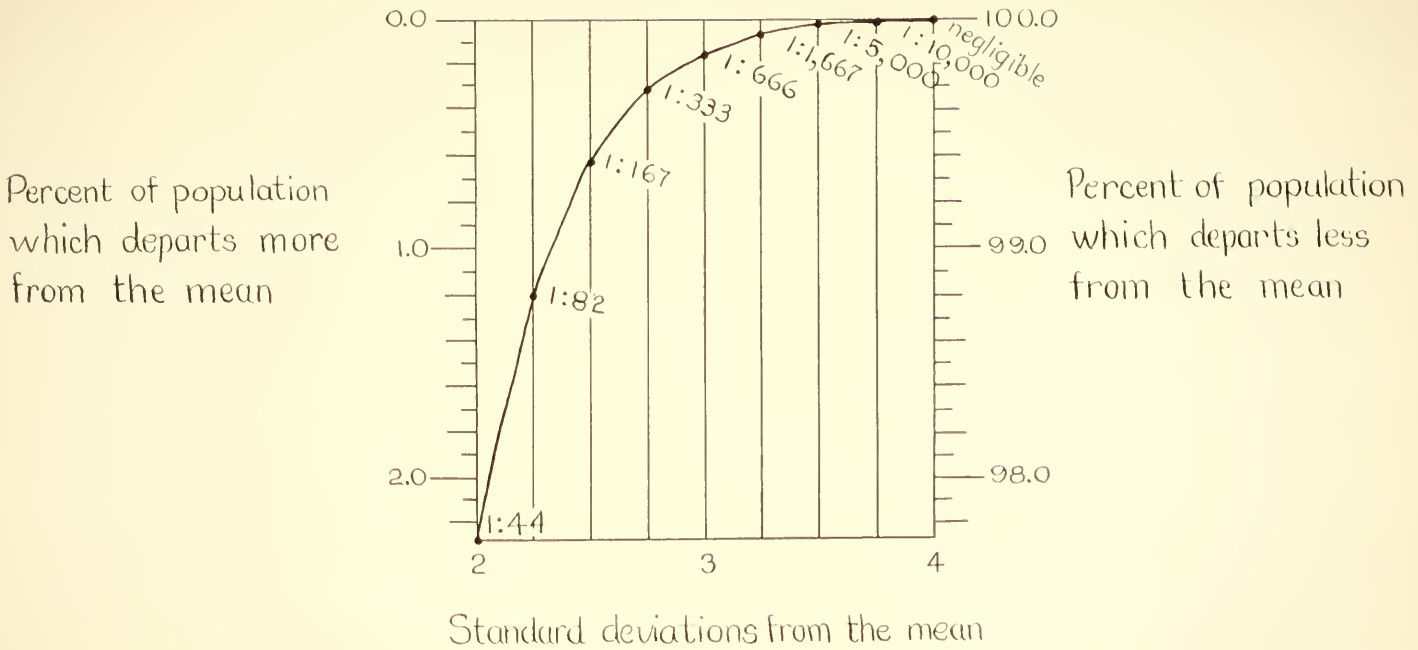

FIGURE 3. Graph showing the percentage of a population which departs (and does not depart) from the mean of the population by two to four standard deviations. (Deviations are above or below the mean, but not both simultaneously.) Representative values are also expressed as odds that an individual taken from a population at random would differ so much from the mean.

tively much, and the radius and ulna relatively little, difference in size between the sexes; the femur showed more sexual dimorphism in the present study.

These data provide certain identification of most birds. The method of interpretation is as follows.

Let us assume that the depth of the keel on the breast bone of a bird of unknown sex is 44 millimeters. From Table 1 we see this exceeds the mean keel depth for hens by about three standard deviations. (It it desirable to use a value for the standard deviation of either sex which is about midway between the calculated deviations of the two sexes.) Turning to Figure 3, it is found that only 0.15 percent of pheasant hens exceed the mean value by so much, or, conversely, 99.85 percent will have shallower keels than the one at hand. The odds that a hen taken at random would have so deep a keel are 1 in about 666. If the keel depth in question exceeded the mean for hens by three and one-half standard deviations the odds drop to one in 5,000. Intermediate values can be approximated from the figure. (These values are functions of areas under the normal distribution curve beyond the stated distances from the mean. The tabulation of these data in Simpson and Roe (1939, page 137) was used in deriving this example, and in preparation of Figure 3.)

As expressed by Mayr, Linsley, and Usinger (1953, page 133) ". . . in biological populations, certain upper and lower extremes do not occur. There is no bee as large as an elephant or as small as a bacterium, no matter how many billions of bees are examined. Even though a finite linear range of a population does not exist mathematically, the part of the curve beyond three and one-half or four standard deviations is of negligible practical importance in work with natural populations."

Thus we may decide that a bone having a keel exceeding the mean depth for hens by three and one-half standard deviations (or more, depending upon the criterion adopted) is almost certainly not from a hen. Do cocks have keels enough deeper to permit identification on this basis? Referring to Figure 4 we see that most, but not all, cocks would be so large.

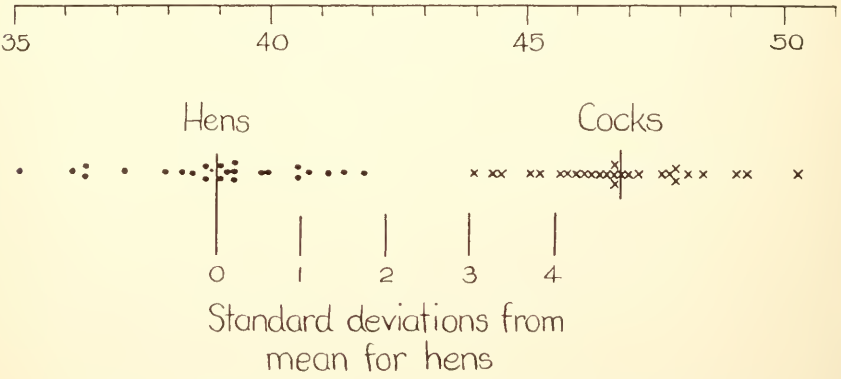

FIGURE 4. Depth of keel of the breast bone in millimeters. Interpretation in text.

More specifically, if three and one-half standard deviations above the mean is taken as the upper limit of variation in hens, then about 91 percent of all cock birds will have still deeper keels. (Taking 1.65 as the standard deviation in each sex, a variance of 3.5 standard deviations from the mean for hens chances to fall 1.37 standard deviations from the mean for cocks. Tables show us that 83 percent of a population falls within these limits, and in this instance only the lower limit of variation in cocks is pertinent.) Eighty percent of cocks will have keels deeper than a value exceeding the mean for hens by four standard deviations. This is to say that 80 to 91 percent of the pheasants that might come to hand can be designated male or female on the basis of this character, depending upon the criterion of certainty adopted.

One would be justified in testing a number of the measures tabulated, and in accepting as evidence the one that best suits one's case; however, as all express differences in size, they do not vary independently, and one may not extend the analysis by employing the product of several probabilities (Hildebrand, 1955).

This could be done with most ratios expressing body proportions, but none of the nine indices tested showed sufficient sexual dimorphism to be useful; several ratios revealed statistically significant differences between the sexes, yet the overlap of values was too great to permit application to single birds. In cocks, the keel of the breast bone is deeper in relation to its length, and several long bones have greater thickness of shaft in proportion to length. Sexual differences in the pelvis that are evident during laying are not useful during the hunting season.

Certain avian bones develop hyperossification under the influence of estrogen (see, e.g., Landauer, Pfeiffer, Gardner, and Shaw, 1941, and citations therein). The head and shaft of the tibiotarsus of 54 pheasants were sectioned and examined for differences in thickness and density of bone. Variation was marked, but, as expected, there was no correlation with sex in these nonbreeding birds.

SUMMARY

To enforce certain game laws it is desirable to be able to sex dressed pheasants. If the kidneys are in place a portion of the sperm duct or oviduct may remain in position. When urogenital structures are not available, linear measures of any of several bones nearly always offer certain identification. Data are tabulated for five suitable measurements, and the method of interpretation is discussed. No useful difference in relative body proportions could be found. Pelvic variation and estrogen-induced hyperossification are useful only during the laying season.

REFERENCES

Hildebrand, Milton
1955. Skeletal differences between deer, sheep, and goats. Calif. Fish and Game, vol. 41, no. 4, p. 327-346.

Landauer, Walter, C. A. Pfeiffer, W. U. Gardner, and J. C. Shaw
1941. Blood serum and skeletal changes in two breeds of ducks receiving estrogens. Endocrinology, vol. 28, no. 3, p. 458-464.

Latimer, Homer B.
1925. Postnatal growth of the body, systems and organs of the single comb white leghorn chicken. Jour. Agric. Res., vol. 29, no. 8, p. 363-397.
1927. Post-natal growth of the chicken skeleton. Amer. Jour. Anat., vol. 40, no. 1, p. 1-57.

Latimer, Homer B., and John L. Osborn
1923. The topography of the viscera of the chicken. Anat. Record, vol. 26, no. 4, p. 275-289.

Latimer, Homer B., and John A. Rosenbaum
1926. A quantitative study of the anatomy of the turkey hen. Anat. Record, vol. 34, no. 1, p. 15-23.

Latimer, Homer B., and H. P. Wagner
1941. Weights and linear dimensions of the skull and of some of the long bones of the mallard duck (*Anas platyrhynchos platyrhynchos*). Univ. of Kansas Sci. Bull., vol. 27, no. 1, p. 15-18.

Mayr, Ernst, E. Gorton Linsley, and Robert L. Usinger
1953. Methods and principles of systematic zoology. N. Y., McGraw-Hill Book Co., Inc., 328 p.

Schneider, M., and L. C. Dunn
1924. On the length and variability of the bones of the white leghorn fowl. Anat. Record, vol. 27, no. 5, p. 229-239.

Simpson, George Gaylord, and Anne Roe
1939. Quantitative zoology. N. Y., McGraw-Hill Book Co., Inc., 414 p.

STUDIES ON THE INCIDENCE OF POULTRY DISEASES IN WILD DUCKS[1]

ERLING R. QUORTRUP, M. E. GOETZ, and J. W. DUNSING
San Diego County Livestock Department
and
MERTON N. ROSEN
Game Management Branch
California Department of Fish and Game

INTRODUCTION

This study was undertaken in order to obtain data on some of the more important diseases transmissible from poultry to wild birds and vice versa. Answers to the problem are of equal interest to the poultry producer and the conservationist or game management agent.

Through the courtesies of the California Department of Fish and Game and the U. S. Fish and Wildlife Service, permission was granted for the trapping of ducks and coots at the Imperial State Waterfowl Management Area at Westmorland and Calipatria, and at the Salton Sea National Wildlife Refuge, all located in Imperial County, California.

Sincere appreciation is expressed to the numerous employees of the U. S. Fish and Wildlife Service and the California Department of Fish and Game who diligently assisted in the difficult task of securing the specimens studied.

METHODS

Blood was taken from the heart, using a 20-gauge needle for the teal and a 19-gauge needle for the larger ducks. The mortality caused by the heart puncture was estimated to be about 5 percent, which is somewhat higher than has been our experience with poultry. A good technician will have about a 2 percent loss when bleeding chickens from the heart.

Approximately $2\frac{1}{2}$ cc. of blood were withdrawn from each bird and taken without delay to the San Diego Livestock Department Laboratory, where the following serological tests were performed: Agglutination tests for *Salmonella pullorum*, *S. gallinarum*, *S. typhimurium*, Arizona paracolon, and a hemagglutination inhibition test for Newcastle disease.

As an adjunct to the survey, an experiment was carried out to determine the susceptibility of wild ducks to Newcastle virus. A virus strain which was known to kill six-week-old chickens in five days following intramuscular injection in dilution between 10^{-4} and 10^{-6} was selected to challenge ducks.

In addition to the serological and virological studies, blood chemistry determinations were made on eight pintails following accepted routine technics.

[1] Submitted for publication September, 1956. This study was financed in part by Federal Aid in Wildlife Restoration Project California W-35-R, "Wildlife Disease Studies".

RESULTS

During February 17 and 18, 1953, blood samples were collected from 313 ducks and 176 coots. Of the 313 ducks examined, 94 were widgeon (*Mareca americana*), 182 were pintail (*Anas acuta tzitzihoa*), and 37 were green-winged teal (*Anas carolinensis*). On March 9 and 10, 1954, additional tests were made on 338 ducks and 5 coots trapped in the same area. Of these, 255 were pintail, 71 widgeon, and 12 green-winged teal.

The birds tested in 1953 were negative for *Salmonella pullorum*, *S. gallinarum*, and Arizona paracolon. One pintail showed a strong reaction to the *S. typhimurium* antigen both in "o" and "H" factors tested separately. Nine coots (*Fulica americana*) showed a strong positive reaction to the *S. typhimurium* antigen and one a suspicious reaction. Five additional coot sera showed a positive reaction to the initial tests 1:25 but were negative in further dilutions.

All coots and green-winged teal showed negative H.I. titers, but five pintail and two widgeon showed positive reactions (Table 1).

In the 1954 survey, all tests for paratyphoid, pullorum, and fowl typhoid were negative. One pintail showed an H.I. titer of 1:128. One pintail and one widgeon showed a positive reaction to Arizona paracolon.

TABLE 1

Positive H. I. Titers in Pintails and Widgeons

Pintail	No. 1	H.I.	Titer	1:128
Pintail	No. 3	H.I.	Titer	1:128
Pintail	No. 17	H.I.	Titer	1:64
Pintail	No. 221	H.I.	Titer	1:64
Pintail	No. 289	H.I.	Titer	1:128
Widgeon	No. 116	H.I.	Titer	1:128
Widgeon	No. 242	H.I.	Titer	1:128

On March 12 three pintails were inoculated with 1 cc. of the virus 1M in dilution 10^{-2}. They were under constant supervision and revealed no symptoms whatever up to March 23, at which time they were destroyed. The blood titers by this time were 1:16, 1:32, and 1:128. On the same day three other pintails were given the same virus in dilution 10^{-4}. On the sixth day one of these birds showed evidence of leg paralysis and died the following day. Apparently this bird died from causes other than Newcastle disease. The other two birds remained unaffected and were sacrificed on March 23. The H.I. titer was 1:16 in all these birds.

Two control chickens were inoculated with the same virus on March 16. On March 19 clonic spasms were noted, and both died with typical nervous symptoms on March 23.

Results from the blood chemistry studies made on the eight pintails are shown in Table 2.

TABLE 2

Blood Chemistry Data From Eight Pintails
(Expressed in Mg/100 cc. of blood)

	Glucose	Non-protein nitrogen	Urea nitrogen	Calcium
1	420	43	3.3	11.2
2	300	40	2.6	9.0
3	350	32	1.7	8.6
4	372	17.5	2.6	5.7
5	460	19.7	3.0	12.0
6	392	47	3.6	12.1
7	210	60	4.2	14.3
8	181	51.2	2.8	13.1
Average	335.6	38.8	2.97	10.75

SUMMARY

Serological tests were made for determination of *Salmonella typhimurium*, *S. pullorum*, *S. gallinarum*, Arizona paracolon antibodies, and H.I. titers on 651 wild ducks and 181 coots. H.I. titers were found in eight ducks, *S. typhimurium* reactions were found in one duck, and Arizona paracolon reactions in two ducks. The coots showed no reaction in any of the tests except to the *S. typhimurium* antigen, to which nine were strongly positive, one suspicious, and five gave an initial reaction in the 1:25 dilution but no reaction in further dilutions.

The incidence of salmonellosis was negligible in the ducks tested, but one-half percent showed exposure to Newcastle disease. Ducks appear refractory to challenge tests to this virus, but may possibly be immune carriers.

The only significant finding in the coots was a relatively high exposure to *S. typhimurium*, with 4.9 percent showing a strong positive reaction.

STUDIES ON THE INCIDENCE OF POULTRY DISEASES IN COOTS[1]

MERTON N. ROSEN
Game Management Branch
California Department of Fish and Game
and
ERLING R. QUORTRUP, M. E. GOETZ, and J. W. DUNSING
San Diego County Livestock Department

INTRODUCTION

A serological survey of waterfowl was undertaken to determine the incidence of Newcastle disease and salmonellosis (Quortrup et al., 1957). This investigation stemmed from the dearth of information available on this subject (Rausch, 1947; Harbourne, 1955) and its importance to game management and conservation, as well as to poultry husbandry.

The study covered three successive winters from February, 1953, to March, 1955. The first winter was devoted to birds in Imperial Valley and San Joaquin Valley. In the second winter, the study was extended to include Sacramento Valley. In the winter of 1954-55, five widely distributed waterfowl areas extending from the Oregon to the Mexican border were chosen as collection sites.

Inasmuch as there appeared to be a negligible incidence of salmonellosis in ducks, the effort during the last two winters was spent on coots (*Fulica americana*).

METHODS

The San Diego Livestock Laboratory performed the serological analyses as described by Quortrup et al. (1957), with one exception. All blood samples taken in 1955 were allowed to clot, the sera separated and refrigerated, and then shipped by air express to the San Diego Laboratory.

In 1953 and 1954 cotton swabs were used to procure fecal specimens of the birds. The swabs were dropped into tubes of selenite F broth and brought to the California Department of Fish and Game Laboratory as rapidly as possible. After an 18-hour incubation period, 0.2 ml. were dallied on bismuth sulfite and D.C.L.S. agar plates and incubated for 48 hours. Typical colonies were transferred to Kligler's iron agar, followed by an incubation period of 24 hours. Positive cultures were transferred to tryptone broth, urea agar, and motility test media. Cultures giving positive reactions in the above media were used to prepare antigen which was tested against polyvalent *Salmonella* antisera. Posi-

[1] Submitted for publication September, 1956. This study was financed in part by Federal Aid in Wildlife Restoration Project California W-35-R, "Wildlife Disease Studies".

tive bacteria were forwarded to the California Department of Public Health typing section.

Coots that died as a result of the heart punctures were autopsied and cultures obtained from the internal organs. In 1955 all coots were sacrificed and complete autopsies performed. The ileo-cecal junction was excised and placed in selenite F broth. Organs exhibiting a suspicion of pathology were divided into two halves, one of which was placed in 10 percent formalin for histo-pathological study, and the other kept under refrigeration for bacteriological study.

RESULTS

During February 17 and 18, 1953, 118 fecal specimens were taken from coots at the Los Banos State Waterfowl Management Area and 11 birds autopsied to attempt isolation of *Salmonella* sp. Two suspicious cultures isolated from the internal organs of the coots were submitted to the State *Salmonella* typing section. One proved to be a paracolon, but the typing section did not identify it further. The other could not be typed, since the specific antiserum was not available. The culture was forwarded to the National Typing Center, which identified it as *Salmonella bessarek*.

Incidental to a collection of specimens from ducks on March 9 and 10, 1954, at the Salton Sea National Wildlife Refuge, five coots were tested serologically and bacteriologically. The results were negative.

One hundred eighty-three coots were trapped at Gray Lodge State Waterfowl Management Area on April 29 and 30, 1954. Blood samples and anal swabs were taken, and 27 coots that succumbed were autopsied. Bacteriological examination of the fecal specimens proved to be all negative for *Salmonella* sp., but several paracolons were isolated. However, one of the 27 birds autopsied yielded a culture of *Salmonella typhimurium*. During the autopsies, four birds with gross lesions in the liver and spleen suggestive of avian tuberculosis were encountered. Smears were prepared and the organisms observed under the microscope. They were acid fast and morphologically similar to *Mycobacterium tuberculosis* var. *avium*. Dubos medium was inoculated, but no growth resulted in the tubes.

In view of the above findings it was deemed desirable to continue the survey for another year, and to obtain an index to the distribution of coot diseases throughout the State. In addition, the United States Fish and Wildlife Service granted permission to collect and autopsy 500 coots. Five areas were chosen, from each of which 100 coots were to be taken. They comprised the Tule Lake National Wildlife Refuge near the Oregon border, the Gray Lodge State Waterfowl Management Area in the Sacramento Valley, the Grizzly Island State Waterfowl Management Area in the Sacramento-San Joaquin Delta, the Los Banos State Waterfowl Management Area in the San Joaquin Valley, and the Salton Sea National Wildlife Refuge near the Mexican border. The dates chosen coincided with the trapping and banding operations of the Department of Fish and Game's Waterfowl Project W-30-R.

The results of the serologic tests are tabulated in Table 1. The bacteriology was negative with the exception of a few paracolons. No evidence of pathological entities, including avian tuberculosis, was found.

TABLE 1

High Titer Serological Reactions of Coots

Date	Location	Number examined	HI	*S. pullorum-S. gallinarum*	*S. typhimurium*	Arizona paracolon
2/17/53	Salton Sea	176	Neg.	Neg.	9	Neg.
3/ 9/54	Salton Sea	5	Neg.	Neg.	Neg.	Neg.
4/29/54	Gray Lodge	183	Neg.	5	39	3
11/ 9/54	Tule Lake	99	Neg.	1*	1*	1
11/25/54	Los Banos	100	Neg.	5*	17	5
12/ 7/54	Gray Lodge	101	Neg.	Neg.	3	Neg.
1/31/55	Grizzly Island	99	Neg.	Neg.	4	1
3/ 3/55	Salton Sea	99	Neg.	1	1	Neg.
	Totals	862		12	74	10

* Indicates cross reaction in blood samples tested.

DISCUSSION

The shortcomings of this work are immediately apparent. No bacteriological evidence of disease was obtained from the anal swab. In spite of a considerable number of serological positive reactions to *Salmonella pullorum-Salmonella gallinarum* and *Salmonella typhimurium*, only one bird was found to be actively infected with the latter organism, and one coot harbored *Salmonella bessarck*. Both of these pathogens were isolated from the internal organs. The completely negative findings on the 498 cultures from ileo-cecal junctions indicate that additional sites should be chosen for culture to determine the incidence of disease.

In the statewide survey, the high incidence of serological reactors in the central valleys might be considered significant, particularly in view of the fact that the coots nest in the areas where the samples were taken. However, at the time of the year when the specimens were taken migrants were common in the areas; therefore, it is difficult to evaluate the incidence on a geographic basis.

SUMMARY

During three successive years coots were trapped for a determination of the incidence of diseases common to poultry. Serological tests were performed on 862 coots for the determination of *Salmonella typhimurium*, *S. pullorum*, *S. gallinarum*, Arizona paracolon antibodies, and H. I. titers. There were 74 reactors to *S. typhimurium* antigen, 6 to *S. pullorum-S. gallinarum*, and 10 to Arizona paracolon. Bacteriological tests done on fecal specimens proved to be uniformly negative. Cultures obtained from internal organs were positive in two birds, one being *S. typhimurium* and the other *S. bassarck*. Four coots observed to have lesions similar to avian tuberculosis yielded organisms that were acid fast and morphologically similar to the cause of this disease; however, confirmation through culture was not successful. It is evident that coots have a relatively high incidence of exposure to salmonellosis.

LITERATURE CITED

Harbourne, J. F.
1955. The isolation of *Salmonella gallinarum* in wild birds. Jour. Comp. Path., vol. 65, no. 3, p. 250-254.

Quortrup, Erling R., M. E. Goetz, J. W. Dunsing, and Merton N. Rosen
1957. Studies on the incidence of poultry diseases in wild ducks. Calif. Fish and Game, vol. 43, no. 2, p. 139-141.

Rausch, Robert
1947. Pullorum disease in the coot. Jour. Wildl. Mangt., vol. 11, no. 2, p. 189.

NOTE

TAGGED DOVER SOLE (*MICROSTOMUS PACIFICUS*) AT LIBERTY SIX YEARS

A dover sole tagged by the California Department of Fish and Game in 24 to 26 fathoms of water off the mouth of Mad River, in Fish and Game block number 202, on July 13, 1950, was recovered from this same general area on August 24, 1956. This fish had been at liberty 6 years 1 month 11 days, or a total of 2,234 days. According to Departmental records, the next lengthiest time at liberty for a tagged dover sole was about 3 years 11 months.

The fish at liberty six years was tagged with a Petersen-disk-type tag made of cellulose acetate, which was attached by a silver-wire pin just below the dorsal fin approximately halfway back on the body. Among the many species of marine and freshwater fishes similarly tagged by the Department only sablefish (*Anoplopoma fimbria*) have been recovered after being at liberty a comparable length of time. A record of 5 years 6 months has been established for the sablefish (J. B. Phillips, personal communication).

The tagged dover sole was recovered on the fillet line at the Hunter and Foland Fish Company at Fields Landing, California. It was part of a load of fish delivered by Mr. Byron Anderson of the vessel WINGA. Unfortunately, only the tags were turned in to Department personnel, but subsequent interviews of employees of the fish company determined the length of the specimen to be "about 15 inches" and that the tag wound was well healed, with no apparent irritation. At the time of release in 1950 the fish measured 13½ inches (344 mm.) in total length.

Mr. Anderson stated that he had been fishing in only two areas: Fish and Game block number 134 off Trinidad Head in 130 fathoms, and Fish and Game block number 211 off Humboldt Bay in 90 fathoms. Both areas are approximately equidistant from the point of release. In any event, the net movement after six years was less than 25 miles.—*E. A. Best, Marine Fisheries Branch, California Department of Fish and Game, October, 1956.*

IN MEMORIAM

CHARLES R. CLOTHIER

It is with real sorrow that we report the passing of Charles R. Clothier, Marine Biologist II, on January 10, 1957.

Mr. Clothier came to work with the Division of Fish and Game in 1935, and transferred to the Terminal Island laboratory in 1945. His willingness to tackle any tough assignment soon earned him the usual reward of the persistent volunteer—more and more of a work load.

He was first assigned to sardine sampling: collecting and measuring fish from the catch and compiling the results. This job later included mackerel, which became his primary assignment. In the meantime his engineering training received at Kansas State College served him in good stead as he took on frequent drafting jobs. Most of the graphs and charts in the Department's marine publications during the last 15 years have been the products of his skill. Last of his three major assignments was the work on identification of fish by their skeletons. Charlie became an expert on preparing and staining fish skeletons. His publication, "A Key to Some Southern California Fishes Based on Vertebral Characters" (Fish Bulletin No. 79), is the most authoritative work of its kind. A second publication was under preparation at the time of his death. In addition to this full schedule, Charlie participated in field trips and carried on other jobs, such as supervising the maintenance men at the Terminal Island laboratory.

Not content with a full work day, Charlie was active in church work and was a gifted choir leader. He was also an amateur magician and his shows entertained his colleagues both in the Department and at his church.

Although knowing what lay ahead, Charlie continued to put his all into his work until less than a week before his death. The courage he displayed has been a challenge to all of us who knew and loved him. It can be truly said that we have lost a friend.—*Richard S. Croker, Chief, Marine Fisheries Branch, California Department of Fish and Game.*

REVIEWS

Pheasants in North America

Edited by Durward L. Allen; The Stackpole Co., Harrisburg, Pa., and Wildlife Management Institute, Washington, D. C., 1956; xviii + 490 p., 33 text figs., 1 colored and 82 black-and-white plates. $7.50.

This book summarizes the available up-to-date information about pheasants in an easy to read, matter of fact style that will make it a valuable addition to any nature library. In short, it has everything. In scope it covers the entire geographic range of the ringneck on the North American Continent, and includes data that begin with the first introductions from Shanghai, China, in 1881 and end with a discussion of modern management techniques.

The total pheasant habitat, which extends from coast to coast, has been divided into seven broad areas: Northwest, California, Southwest, Plains and Prairies, Great Lakes, Pelee Island, and Northeast. Several leading authorities describe in detail the life history, habits, management problems and techniques, predator relationships, environmental requirements, limiting factors, history, and hunting problems peculiar to their own particular areas.

"Pheasants in North America" is a "must" for professional game bird biologists and managers and should be widely used by wildlife students in colleges and universities. That part of the general public truly interested in this valuable resource can gain much important information by reading this volume, and thus will be in a better position to assist their game administrators in enacting sound management legislation. This fact alone makes the book well worth its price.—*Harold B. Clemens, California Department of Fish and Game.*

The Last Passenger

By James Ralph Johnson; The MacMillan Company, New York, 1956; 116 p., illus. $2.75.

It has been a little over 40 years since the passenger pigeon passed into extinction. According to the literature, the last passenger pigeon died in the Cincinnati Zoo in 1914. This book depicts the life story of "Blue", an imaginary passenger pigeon, the last survivor of that species in the wild.

Although Blue is an imaginary bird, this story is accurate and based on a sound research of the subject. The story is well told and is easy reading. The author follows Blue from the time he is an egg in the nest through all the perils of his world. As in the recent series of nature movies, all emphasis is on the constant struggle for survival. One gets the impression that myriad enemies confront the bird at every hour of the day and night. Undoubtedly, all the incidents related happen to various birds, but it is highly unlikely that any one bird would experience all these hazards.

The author recognizes the clearing of the beech forests as one of the factors contributing to the decline and ultimate extinction of the passenger pigeon; however, the average reader will probably only remember the vivid accounts of the many forms of slaughter of pigeons by market hunters.

The book has 10 very good full-page, black-and-white illustrations by the author. —*Wallace G. Macgregor, California Department of Fish and Game.*

Hunting Our Biggest Game

By Clyde Ormond; The Stackpole Co., Harrisburg, Pa., 1956; 197 p., 14 figs., and 32 plates. $5.

The author and publisher have exercised good judgment in book design, as evidenced by the selection of an attractive cover that creates reader interest, moderation in size—permitting one to easily complete it during an evening, and use of a dull finish paper that eliminates eyestrain.

This book is concerned with big game trophy hunting in North America. A game animal that is large in size, that presents the hunter with an element of personal danger, that is relatively scarce in numbers, and that inhabits rugged terrain —making it difficult to hunt, is considered as belonging in the trophy class. Grizzly bears, moose, elk, caribou, mountain goats, and mountain sheep meet the author's requirements.

These animals are discussed in some detail from personal experiences, as well as from experiences of other trophy hunters. Various habits and habitats of each game species, along with hunting tips, are revealed in a style well spiced with yarns and "salty" expressions that succeed in holding the reader's attention.

The hunter who is planning to make his first big game trip will find this book full of advice about how to plan a trip, estimate costs, select a gun, properly load pack animals, choose and set up a good camp site, and many other things that will serve to make a hunting trip enjoyable.

The armchair hunter will find equal pleasure in the charts, line drawings, and photographs.—*Harold B. Clemens, California Department of Fish and Game.*

Salt Water Fishing Is Easy

By Jerry Sylvester; The Stackpole Co., Harrisburg, Pa., 1956; xiv + 208 p., illustrated by James M. Wilcox. $3.95.

To be asked to write a book is a compliment. But to write a book is a real accomplishment—particularly when the content is largely the result of wide and varied experience. Jerry Sylvester, the author of "Salt Water Fishing Is Easy", is evidently considered the outstanding saltwater angler on the Atlantic seaboard. His book is an unmistakably straightforward presentation of a wealth of information that can be obtained only from a man who knows his business.

In a manual of this type, there must be space devoted to tackle, fishing methods, baits and their presentation to the fish, and some discussion of the right season to fish for the various species. All of these sections are included in "Salt Water Fishing Is Easy", and also a glossary, a section devoted to the preparation of fish, and an important section having to do with the fisherman's principles.

For the angler on the Atlantic coast, this book is sure to be a boon; and for the armchair fisherman, wherever he might be, a breath of refreshing salt air.—*Parke H. Young, California Department of Fish and Game.*

The Underwater Guide to Marine Life

By Carleton Ray and Elgin Ciampi; A. S. Barnes and Co., New York, 1956; xiv + 338 p., illustrated by Teiji Takai. $8.75.

The conservation message contained in the introduction is a masterpiece of writing. It points out, in a few brief paragraphs, the consequences of man's threatened overexploitation of the seas—concepts generally overlooked or ignored by many present-day fishermen, both sport and commercial, in their eagerness to grab all they can today, completely oblivious of tomorrow's needs.

The excellent photographs liberally sprinkled throughout the text attest to the qualifications of the authors to write on the subject of undersea photography and, as a result, the chapter on this subject is especially good. In several other chapters, such varied subjects as zones, dangers, and biology of the sea, evolution, names, and classification are dealt with.

The entire undersea world of botany, including diatoms, algae, and flowering plants, is dismissed after an inadequate 10 pages of general to specific discussion. Reptiles, birds, and mammals have only 21 pages dedicated to them, while invertebrates receive the complete treatment in 46. Fishes receive the bulk of attention, with 171 pages devoted to varying accounts of size, weight, distribution, identification, and habits. Representatives of nearly all major groups are considered and many are illustrated with recognizable drawings. Pacific Coast forms are most noticeable by their absence and what little treatment they do receive generally reflects the dependency of the authors upon books and other published accounts for much of their knowledge. Typographical errors in scientific names indicate unfamiliarity with the subject. Other errors creep into discussions of distribution, relationships, description, and so on. The authors' selection of what constitutes "representative" species is subject to question. Many of the pitfalls into which they have stepped could have been avoided by a better working knowledge of the beasts in question. Regardless, the over-all work is commendable in its field and the authors may be proud of their accomplishment.—*John E. Fitch, California Department of Fish and Game.*

How to Know the Seaweeds

By E. Yale Dawson; Wm. C. Brown Co., Dubuque, Iowa, 1956; vi + 197 p., illus. Spiral bound $2.25; cloth bound $2.75.

A short general discussion on the vegetation of the sea is followed by similar short passages on how to collect and preserve seaweeds and brief discussions of life histories, nomenclature, and reproduction.

The illustrated key makes up the bulk of the text and, though simplified for use by the beginning student, is still too technical and complicated to use without ready access to a microscope. In some instances preparation of stained slides would be advisable. The line drawings are excellent and of invaluable assistance. Algae and marine flowering plants from both coasts of the United States have been included. Species that are very small, rare, or of localized occurrence have been omitted and the illustrations do not include all of the various genera. Regardless, a student of phycology should be able to identify, by use of the key, most of the marine plants he is likely to encounter within the area encompassed by the volume.

The key is followed by a phylogenetic list of genera and an index and illustrated glossary. The size of the book (5½" x 8⅜") makes it quite handy for carrying into the field. The author is one of the most capable practicing algologists in the world today.—*John E. Fitch, California Department of Fish and Game.*

"Whale Off!" The Story of American Shore Whaling

By Everett J. Edwards and Jeannette Edwards Rattray; Coward-McCann, Inc., New York, 1956; xxiv + 285 p., illus. $10.

"Whale Off!" is the story of American shore whaling, a neglected facet of this ancient industry. The first printing of this book (1932) has long been exhausted and the original volumes have become collectors' items, attesting to the high value placed upon the story. A book such as this, derived from the beginning pages of our great nation's history will never be discarded as outdated or thought to be of passing interest only. As a matter of fact, each reading will increase its value and serve to remind us of our humble but inspirational past.

A great deal of highly favorable comment could be written about this book. From the point of view of the historian, the hunter, the fisherman, or anyone who enjoys reading, a more satisfactory book would be difficult to find.—*Parke H. Young, California Department of Fish and Game.*

Here Come the Whales!

By Alice E. Goudey; Charles Scribner's Sons, New York, 1956; 94 p., illustrated by Garry MacKenzie. $2.50.

This delightful little book is one of a nature series written for young children. The type is large and the sentence structure is simple enough for the youngest reader to understand.

The subject matter is treated in story-like form, so the child can identify himself with the whales. A great many scientific facts presented throughout the text give information on such items as: size at birth and as full grown adults, nursing and feeding habits, enemies, breeding grounds, and migrations.

The book first informs the reader about blue whales. Shorter sections follow on sperm whales, gray whales, narwhales, and bowhead whales. A final section presents a good description of the whaling industry and tells of their capture and processing by whaling ships. The numerous valuable products obtained from whales and use of these products by man are discussed.

The illustrations are black sketches on a blue background of water and sky and are not especially detailed, but the artist, Garry MacKenzie, has done a superb job.

This book is highly recommended as an addition to a child's library. The accounts are accurate and the story is told in a manner that young readers can understand. —*Charles R. Clothier, California Department of Fish and Game.*

Rattlesnakes: Their Habits, Life Histories, and Influence on Mankind. Volumes 1 and 2

By Laurence M. Klauber; University of California Press, Berkeley, 1956; 1,530 p., 243 illus. $17.50.

These volumes represent the culmination of over 35 years' study of rattlesnakes and other reptiles by a man whose careful work and large number of valuable publications have made him outstanding in this field. They are not only the result

of the author's years of personal study of rattlesnakes in the field, particularly in the southwestern United States, and in the laboratory, but also a compendium of both the published findings of others and the unpublished findings which the author solicited by letter from a number of persons. They constitute, as he says, an encyclopedia of the rattlesnake.

All the rattlesnakes of North, Central, and South America are included, with keys by regions, distributional maps, and excellent photographs and detail drawings. The major portion of this work is devoted to what might be called the natural history of the rattlesnake: general behavior, habitats, growth, feeding, reproduction, poison, the rattle, relation to other animals, and so on. In addition, there are sections on American Indians and their attitude toward rattlesnakes, and on the large amount of folklore connected with these snakes. Finally, there is an extensive bibliography and a very complete index.

All this information is not only presented with the accuracy and thoroughness for which the author is noted among his fellow workers in the field of herpetology, making it a work of great value for the biologist, but is also written in such a lucid and readable style that it holds great appeal for the general reader. The reviewer may be slightly prejudiced, having been interested in reptiles herself for a number of years, but has found that most other people are tremendously interested in seeing and hearing about them. They may be afraid of them and know very little about them, but their interest is often the greater for these reasons. I feel that almost anyone could open these volumes at almost any page and find fascinating reading.—*Anita E. Daugherty, California Department of Fish and Game.*

Wildlife Law Enforcement

By William F. Sigler; Wm. C. Brown Co., Dubuque, Iowa, 1956; xiv + 318 p., illus. $4.50.

The preface of "Wildlife Law Enforcement" makes two points: a book on fish and game law enforcement has been long overdue, and work as a wildlife law enforcement officer should properly be termed a profession.

Although a present-day bibliography of police methods and administration would be quite lengthy, little has been done heretofore in the field of books treating the unique work of a warden: "unique" because it is neither solely police science nor wildlife management, but a combination of the two. Since references to the skills and attitudes of a competent warden are mainly confined to in-service training publications developed by the wildlife protection branches of various states, "Wildlife Law Enforcement" should be a welcome addition to the libraries of those who are concerned with this subject.

To the young person who aspires to a career as a warden, the book will provide a source of detailed information regarding the historical development and present requirements of the profession. As such, it is especially recommended, for it will do much to resolve the maze of written materials through which the aspirant previously had to wind in order to prepare himself for appointment as a career wildlife protection officer.

Veteran wardens will be acquainted with much of the information presented in the book. However, its use is recommended both as a short "refresher course" and as a means of becoming familiar with certain skills which improve effectiveness as an officer.

The 11 chapters cover in fair detail the history of law enforcement, jurisdictions over wildlife, rights of citizens under wildlife law, violations and wildlife management, and professional methods of wildlife law enforcement officers. Of particular values are the many synopses of cases and decisions rendered by courts throughout the Nation.

The book includes three appendices: definitions and legal terms; the general wording of legal forms used in fish and game work; and sample examination questions, which should be of equal interest to seasoned wardens and novices.

A useful reference section of bibliographies is included in the book.

Summing up: "Wildlife Law Enforcement" puts within two covers a host of information previously gleaned only by virtue of long searching.—*John O. Rhien, Jr., California Department of Fish and Game.*

Dictionary of Poisons

By Ibert and Eleanor Mellan; Philosophical Library, New York, 1956; 150 p. $4.75.

The publishers of this small book recommend the volume "to everyone who may sometime or another be called upon to render first aid to a victim of poison."

The worker in conservation will have more reason than he average citizen to be concerned with poisoning by so-called economic poisons, snake, spider, and insect bites, and poisonous plants. The book was judged accordingly, with the field man in mind.

Immediately difficulty arises. The field man must know at once (assuming he is to use this book to fullest advantage) what the poison is. Suppose it is Lindane; this is not listed. But if the worker knows that Lindane is the gamma isomer of benzene hexachloride, then he can find the reference.

No Malathion is listed, neither is it present under O-o-Dimethyl Dithiophosphate or Diethyl Mercaptosuccinate. Parathion is listed. Systox is not. Does the average field worker know that these are all so-called "organic phosphates"? TEPP (tetraethyl pyrophosphate) is not listed, yet commonly used.

The heading of "Economic Poisons" on page 15 breaks down into a definition of economic poison, which in turn leads into subgroups, of interest in a dictionary, but not essential for first aid.

Page 73 has another heading "Economic Poisons." After reading this page and the next and discovering that economic poisons (Pesticides) ". . . cover *all* (emphasis mine) groups of substances now known and used in the unrelenting war on man's ubiquitous enemies" and that "the benefits of economic poisons to public health and wealth are vast and spectacular" I find that they are classified into two main groups, the chlorinated hydrocarbons and the organic phosphorus compounds. Some are listed. But still no Systox, Lindane, or TEPP.

No mention is made here of many inorganic economic poisons in common use, such as zinc phosphide, mercurials, selenides, thallides, arsenides, etc. Nor of organic economic poisons such as strychnine, nicotine, chloropicrin, etc. However, these do appear under their alphabetical headings, along with 2, 4, 5-Trichlorophenoxyacetic acid. Do many field men know this is used in "animal bait"?

I could not find any reference to either "1080" or to Sodium Fluoroacetate! However, page 82 had a heading "Fluoride Containing Compounds." The known toxicity of "1080" is in sharp contrast with the information on antidotes and first aid, although this is applicable to other fluoride containing compounds.

A list of generalized symptoms follows, in which every unpleasant physiological and psychological reaction I can think of is present. Not useful in diagnosis.

Poisonous plants, including those poisonous by contact, such as poison oak and poison ivy, in general receive only a limited discussion. The same remarks apply to the subject "Insects", in which is included a discussion of scorpions and spiders.

Snake bite is snake bite to the authors; no regard is given to a nonpoisonous snake bite. The treatment is given twice: once in the discussion under the heading "Snakes", and once in the following heading "Snake Bites." In the first, suction is to be applied, in the latter no mention is made of suction.

The topic "Spiders" is limited entirely to a discussion of the black widow spider, "America's most poisonous spider." It is reassuring to know that "death is not always inevitable." The antidote and first aid treatment consist of putting the victim to bed, applying tincture of iodine to the site of the bite, and calling a physician.

Pages 7 through 14 are useful and the substance of all the first aid given in the book is the administration of "Universal Antidote", followed by an emetic, except in the case of corrosives. "CALL A PHYSICIAN!" is scattered throughout the book after most poisons but not after others, such as acetone and antimony.

In summary, this book is improperly titled a "Dictionary of Poisons". It is a professional writer's concept of "what to do 'til the doctor comes", with some very incomplete discussions and these of only a few poisons. The book is written in "down-to-earth language" and plays so safe with generalities that it would be of no use to anyone except to a casual reader wishing to pick up bits of information otherwise limited to standard first aid manuals, medical texts, or newspapers. Moreover, it is extremely poor in its organization and may be dangerously misleading in its omissions and peculiar emphases.

The price of $4.75 seems too much to pay for seven pages of a good discussion of emergency treatment and preparation of antidotes.—*Harold D. Bissell, California Department of Fish and Game.*

Living Off the Country (How to Stay Alive in the Woods)

By Bradford Angier; The Stackpole Co., Harrisburg, Pa., 1956; 241 p., illustrated by Vena Angier. $5.

"The wilderness is too big to fight. Yet for those of us who'll take advantage of what it freely offers, nature will furnish every necessity."

The wild country holds a mighty appeal for Bradford Angier. He obviously delights in garnering the food, shelter, and clothing it provides. But he also treats it with the cautious respect a herpetologist might give a prized king cobra. His book is a warm introduction to his schizoid friend, the wilderness, explaining how to establish the sort of relationship of pleasure tempered with caution which he clearly enjoys.

The general principles of living off the country are outlined lucidly, with proper emphasis on common sense. Details center around sources of food, warmth, clothing, and shelter. The excellent material on finding your way and staying oriented is presented so a Boy Scout should grasp it readily. This is a distinct credit to the author.

There is a difference here from the usual survival manual with its total emphasis of what to do when you're suddenly dropped into the jungle with a pocket knife and little else. The full attention Angier gives to better woodsmanship as a source of outing pleasure puts the text in touch with reality. This enhances the survival message.

Parts of the book, especially those on foods, have an intriguing "Believe it or not" quality. Nettles, the cambium of trees, lichens, rose hips, deer antlers in the velvet, the fresh skin of almost anything, the leavings of predators, grubs, and a host of other improbable nourishments are all on the menu, with the general admonition not to be squeamish nor to overlook any possibilities when you're in real trouble.

Other parts of the book, especially those on approaches to life-or-death crises, are properly solemn. They are also very good.

The author's main personal interest clearly lies in the northern wilds of Canada, where he has apparently taken up residence mainly from love of the country. He draws heavily upon this area to illustrate his points. However, his general principles apply anywhere, and the special problems of desert and jungle survival are also given some attention.—*Alex Calhoun, California Department of Fish and Game.*

Responses of Vegetation to Fire

By James R. Sweeney; University of California Press, Berkeley, 1956; University of California Publications in Botany, vol. 28, no. 4, p. 143-250, 10 figs., 16 plates, $2.

This bulletin reports a study of herbaceous vegetation following chaparral fires. Most investigations in the past have been concerned with the responses of woody vegetation species to burning. As a result of this study of herbaceous vegetation, as it occurs and is affected by chaparral fire, it was concluded that "the vast majority of plant seedlings occuring on burns are from viable seeds present in the soil before the occurrence of fire. The dispersal of seeds onto burns from plants present on adjacent sites does not contribute materially to the herbaceous cover. The marked population changes during the first, second, and third years on burns are attributable to differences in germination behavior of seeds of different species and the action of fire in stimulating germination and providing suitable habitat conditions for plant growth. Plants which characteristically occur on burns possess genetic predetermined physiological tolerances which preadapt them to the fluctuating environmental conditions present in chaparral regions frequented by fire. The frequent occurrence of fires is essential to the persistence of certain herbaceous species in the flora of the chaparral regions."—*William P. Dasmann, California Department of Fish and Game.*

Fishbait Culture and Care

By S. Bradley Krochmal; R.F.D. No. 1, Alton, New Hampshire, 1956; 44 p. $1.

The California Department of Fish and Game receives many inquiries concerning the care and culture of various kinds of fish baits. Undoubtedly, fish and game departments of other states do, too. In the past, it has been necessary to hunt up answers in scattered leaflets and publications and has not been possible to refer the inquirer to a single source of information. Krochmal's booklet supplies many, if not most, of the answers to the questions most frequently asked.

Written in an easy-to-read style, this handy manual presents information on collecting, rearing, storing, and selling both the usual and less frequently used freshwater baits. Included are earthworms, minnows, suckers, smelt, hellgrammites, crayfish, frogs, crickets, grasshoppers, cockroaches, meal worms, and other natural baits. The booklet also contains hints on fishing with the different baits described.

The author writes from first-hand experience of long standing. Both fishermen and bait dealers should find his booklet well worth the dollar cost.—*Leo Shapovalov, California Department of Fish and Game.*

Fresh and Salt Water Fishing

By Stan Smith; Dell Publishing Co., Inc., New York, 1956; 145 p., illus. $0.75.

Probably most anglers have at least an occasional yen to try their luck in some far-away place. The first part of this guide maps and describes briefly 151 "hot-spots" in the United States, Alaska, Canada, and Latin America and lists information on clothing, equipment, travel rates, and license fees. It also offers suggestions as to what the wife not fishing might do in the various places and, perhaps most important of all, tells to whom to write for detailed fishing information.

The second part of the booklet contains a number of individual articles on fishing for various freshwater and saltwater fishes and on tackle.

As is almost invariably the case with wide-scale compilations, there are some specific errors. Also, many an angler will snort indignantly to find his favorite water omitted from the list of 151 great fishing spots. On the whole, however, the average angler will glean a fair picture of the kinds of fishing available over the area covered.—*Leo Shapovalov, California Department of Fish and Game.*

Kingdom of the Beasts

By Julian Huxley; The Vanguard Press, New York, 1956; 80 p. and 175 photogravure plates, 3 in color, by W. Suschitzky. $12.50.

This book is very easy to read. Representative mammals, extinct and living, are described in a way that emphasizes their outstanding characteristics. This is done with a humor that makes the mammal and its individuality easy to remember. Who could forget the fish-catching ability of the polar bear after reading of the one "presented by the King of Norway to his Royal Brother of England in the 12th century, let out from the tower at the end of a long rope, and catching Thames salmon?"

The author explains why the various mammals are what they are and how they have become what they are. Adaptive radiation, as well as evolution, is discussed.

The photographs, by Suschitzky, are exceptionally fine and like Huxley's text, point up each subject's outstanding characteristic. There is a short section on the methods he employs in animal photography.

The plates are numbered and not titled, which makes it necessary to turn back to the section titled "Notes on the Plates" to find the identifying titles and other information. This is a bit tedious but there is the advantage that the notes are not affected by space requirements.

An outstanding quality of this book is that it is one that will be enjoyed by the whole family and often reviewed. Children of all ages are fascinated by the pictures and the adult members of the family must read the text to answer their questions. —*James D. Stokes, California Department of Fish and Game.*

Man and the Underwater World

By Pierre de Latil and Jean Rivoire (translated from the French by Edward Fitzgerald); G. P. Putnam's Sons, New York, 1956; 400 p., 55 figs., and 15 plates. $5.

"Man and the Underwater World" is a history of the evolution of man's interest in the seas and of his efforts to conquer and to explore the underwater world by means of mechanical aids which have extended his intimate contact with this environment.

The evolution of free diving starts with the relatively unequipped skin diver of antiquity who dived for sponges, coral, and pearls, and ends with our modern diver equipped with self-contained "aqua lung-type" gear that is used for sport, for scientific observations, and for commercial projects.

The origin, development, and uses of diving bells, bathyspheres, bathyscaphes (free floating or descending water balloons), as well as man's struggle to gain knowledge of the physics and physiology of diving and their effects upon man, are well described and illustrated by suitable photographs and drawings.

"Man and the Underwater World" is the product of considerable research with old manuscripts for material and copies of prints used in this work.

This book is recommended for those whose interests take them to the sea.—*Jack W. Schott, California Department of Fish and Game.*

o

printed in CALIFORNIA STATE PRINTING OFFICE

49892 1-57 5,200

STATE OF CALIFORNIA

FISH AND GAME COMMISSION

Notice is hereby given that the Fish and Game Commission will meet on April 5, 1957, in the California State Building, Los Angeles, California, to receive recommendations from its own officers and employees, from public agencies, from organizations of private citizens, and from any interested person as to what, if any, orders should be made relating to birds and mammals, or any species or variety thereof, in accordance with Section 16 of the Fish and Game Code.

FISH AND GAME COMMISSION
WM. J. HARP
Assistant to the Commission

STATE OF CALIFORNIA

FISH AND GAME COMMISSION

Notice is hereby given, in accordance with Section 14.2 of the Fish and Game Code, that the Fish and Game Commission shall meet on May 31, 1957, in the Employment Building, Sacramento, to hear and consider any objections to its determinations and proposed orders in relation to birds and mammals for the 1957 hunting season, such determinations and orders resulting from hearing held on April 5, 1957.

FISH AND GAME COMMISSION
MONICA O'BRIEN
Secretary to the Commission